

DUOPOLY MARKET STRUCTURE IN A COMMUNICATIONS INDUSTRY
THE U.S. CELLULAR TELEPHONE EXPERIENCE

By

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Cellular telephone local markets in the U.S. represent a rare example of virtually pure duopoly market structure. This creates an unusual opportunity to study empirically the impacts of duopoly. From the results, we can assess the effectiveness of duopoly in meeting public interest objectives. Data for prices and service characteristics are available for the first 30 markets where cellular was implemented, for the first six years of service. Indices are constructed on the basis of these data which reflect four types of firm behavior which could be considered competitive in nature. The markets are assessed according to the intensity of competitive behavior which was exhibited during this period. The behavior and the results are then analyzed to determine how well six public interest objectives are being met in the duopoly cellular markets.

CHAPTER I

OVERVIEW

The trend to demassification of the media continues unabated in technologically advanced societies (Aumante, 1989). Even as the traditional mass media split into ever more specialized segments, they are being complemented and supplanted by digitized services designed to deliver more specific material to smaller and smaller niche audiences (see Merrill & Lowenstein, 1971, and Maisel, 1973). The ultimate information service--tailored to the preferences of each individual user--has been technologically possible for some years. It may now be only a matter of time before this will become economically feasible on a large scale.

As the media demassify, they become more and more like point-to-point communication channels--telephone, individualized letters, even conversation. This demassification trend focuses attention on a communications medium which has received relatively little scholarly attention--the telephone. While the traditional mass media have been the subject of a great deal of research over the last several decades, telephone and other point-to-point means of communication have remained stepchildren.¹

The technological trend in the media has been paralleled by--and perhaps related to--a regulatory trend. In the United States, and increasingly in other developed countries, deregulation and privatization of telecommunications channels have been developing for two decades. There is less overt government control over both content and economic aspects, accompanied by an increasing reliance on competition to accomplish the goals of society. The free market is being allowed to replace the old

regulatory institutions as both the architect and guardian of the public interest. The belief is growing that the users themselves are the best judges of what consumers want and need, and that government only needs to make it possible for them to exercise freedom of choice.

In a landmark action, Congress in early 1996 passed, and President Clinton signed, the Telecommunications Act of 1996 (S. Res. 652, 1996), which in large part deregulates local telephone service. Once certain conditions are met, the regional Bell operating companies (RBOCs) will be free to enter information services businesses, cable TV companies are now free to offer local telephone-like services, and long distance providers are being allowed to offer local services as well. The Federal Communications Commission (FCC) is overseeing the transition to deregulation. The agency has developed a schedule for the transition, and has begun issuing regulations to facilitate it. This opens some interesting possibilities for cellular firms, which are local in nature but in large part owned by much larger parent companies, to offer new services and form alliances with cable and long distance providers.

Regulation, presumably, is intended to protect the consumer and to induce the regulated industry to meet the needs of the consumer. If the free market is being substituted for regulation to meet social goals, it is appropriate that we examine how well the free market is meeting these objectives. That is the purpose of this study.

In decisions in 1981 and 1982, the Federal Communication Commission, after several years of study, lobbying by interest groups, debate, and changes of course, decided that the cellular telephone industry in the U.S. would be structured as a series of duopoly markets (Cellular Communications Systems, 1981; Cellular Communications Systems (modified), 1982). That is, there would be no more than two licenses issued to provide cellular service in each geographic cellular market. Implementation of this decision began in 1983 when the first cellular service was offered in the Chicago market, and within four years, there were two vendors in operation in all of the 30

largest markets in the country. Since then, several hundred similar duopolies have been formed in smaller markets.

It is probably the largest duopoly experiment ever. Although duopoly markets are by no means unknown, the structure is usually the result of economic factors which limit a market to two viable firms, or it is a stage in a growing market which eventually may have more firms or a contracting market which may eventually become a monopoly. Where duopoly markets do exist, they are likely to encounter outside competition at the fringes, or be subject to the threat of entry by new firms. Thus, duopoly markets tend to be fluid and ill-defined.

Due to a novel mix of regulation, geography, and politics, American cellular telephone customers are consigned to local duopoly markets. This presents an unusual opportunity for investigation into the operation of duopolies in practice, and the implications of the duopoly market structure for public policy.

Utilizing the paradigm of economics, this study will attempt to analyze the behavior of firms in duopoly cellular telephone markets and assess their performance in terms of serving the public interest.

Cellular Telephone Technology

Cellular telephone (or cellular radio, as it is often called in the industry) is based on the concept that many small radio transmitters can cover an area as effectively as one large one, and make more efficient use of available radio spectrum. This is because radio frequencies can be reused in cells which are not contiguous with one another. The cells using the same frequency band must be separated by enough distance so that they do not interfere with one another on the air. This is accomplished by keeping the transmitter power in each cell relatively low, thus limiting the range.

Cellular telephone technology uses the frequency modulation (FM) mode of transmission, operating at high frequencies. The FCC, when it decided to establish two

competing systems in each market, set aside 40 MHz in the 800 MHz area, with 20 MHz for each local system. In 1986, 5 MHz was added for each system. The current spectrum allocations are 824-849 MHz, and 869-894 MHz (Lee, 1989).

The radio technology used in cellular radio was well-proven by the time the first experimental systems were being built in the late 1970s. The genius of the idea lies not in arcane technology but in the innovative architecture which used established technologies. The information for the following explanation is from Gibson (1987), chapters 3-6, except where noted otherwise.

A mobile radiotelephone system consists of a transmitter/receiver for each cell, which is fixed and able to interface with the wireline phone system, and the various mobile or portable transmitter/receivers with which the fixed one communicates. FM has two attributes which lend it to such use: The level of static or other outside interference is low, and receivers tend to filter out the strongest signal at a given frequency and ignore others on the same or adjoining frequencies. It is also line-of-sight, which limits its range.

The mobile station consists of a handset, a transceiver (transmitter/receiver), and an antenna. The handset is an elaborate version of an ordinary telephone. The handset is connected to the transceiver, which serves as FM transmitter, receiver and logic unit. In autos, the transceiver box is ordinarily placed in a corner of the trunk. The transceiver connects to an antenna on the outside of the vehicle. The unit draws its electric power from the vehicle's electrical system. So-called bag phones, which are not permanently installed, have the transceiver and antenna in a single unit inside the passenger compartment, and draw their electric power through the cigarette lighter.

The mobile unit transmits to and receives from the cell site, which is the cell transmitter/receiver. The cell site includes the radio transmitting equipment, the antenna, a tower or building on which the antenna is mounted, and a building or shelter to house the equipment. In cities, cell sites are often located on top of business

buildings. The cell site equipment not only maintains contact with the mobile units, it does other housekeeping tasks like setting up and terminating calls, performing the handoff routine, and system testing.

The cell site is under the command of the mobile telephone switching office (MTSO), which controls the entire cellular system for a region. The heart of the MTSO is a minicomputer. The operational task of the MTSO is to interface the calls with the public switched telephone network (PSTN). This, however, is a complex task. The MTSO monitors calls and decides when a call should be switched to a new cell; it keeps track of timing and billing, and evaluates the system for possible problems. Some systems split the master control responsibilities between an MTSO and smaller, remote computerized switch installations.

When the mobile station user wants to make the system available, he turns on or "powers up" the unit, which puts it into an idle state, ready to transmit or receive calls. The receiver monitors cell frequencies and locks onto the strongest cell signal in the area. The mobile unit monitors a paging channel, on which identification numbers are transmitted from cell sites for units being called. If a call is signaled, the mobile unit sends its ID back to the cell site via a setup channel, and the cell site relays the response to the MTSO. The MTSO in turn assigns a voice channel which is not in use, and the mobile unit automatically tunes to that channel to take the call.

To initiate a call, the caller enters the digits in a keypad, like that of any Touch Tone phone. The number to be called is shown in a display, so it can be verified or modified before the call is actually initiated. The caller presses a "send" button, causing the mobile transceiver to transmit the number to the cell site with the caller's ID number, requesting a voice channel. The request is relayed to the MTSO, which assigns the channel. The transceiver switches to the assigned channel, and the MTSO completes the requested call through the wireline system. When the call is answered, the mobile user can either use the handset like any other phone or, in many

installations, use a remote speaker, leaving the hands free. When the call is completed, pushing the "end" button will terminate or "hang up" the call.

Since the vehicle may be moving during the call, it may be necessary to transfer or "hand off" the call to a different cell. The MTSO is constantly monitoring the strength of the mobile unit's signal, just as the mobile unit is constantly monitoring the strength of cell signals. When the mobile unit's signal drops below a minimum level, the MTSO directs that the call be switched to another channel, either in the same cell or an adjoining one. The mobile unit and the cells switch or hand off channels at virtually the same time, so the phone user usually is unaware that a handoff has taken place. The handoff takes less than 0.2 seconds. Signal strength monitoring is an important function, as the wattage of the mobile units is less than cell site transmitters, so the ability to clearly receive the mobile unit signal is a critical part of the process.

A problem in the first few years of cellular phone systems was the situation of the "roamer", the user who drives between various areas with different cellular systems. In many cases, the roamer could not use his cellular telephone in another city, because he was not a local subscriber. Gradually, local system operators have been forming intercity agreements, so that roamers can use the mobile phones in other cities, with access ability and proper billing. Another solution to the roaming problem has been the gradual merger of local systems into national networks.

When a cellular system is first set up, the engineering requirement is that it be covered as thoroughly as is practical by the cell sites. Problems due to terrain and tall buildings may complicate the task. As of early 1986, Nynex was using 48 cells to cover the New York City market, while competitor Metro One had 24. BellSouth Mobility covered the Jacksonville, Fla., market with six cells. Some small markets required as few as two or three cells initially (Gibson, 1987).

As the number of users grows, mere geographic coverage is not adequate, however. Some cells will experience high traffic, resulting in an unacceptably high

level of blocked calls due to excessive demand. The technological response is division of the cells, called cell-splitting. This can take one of several forms. A single cell site may be equipped with three transmitters instead of one, each of which transmits to a 120-degree arc instead of a full 360. The original site can be abandoned and other transmitters set up to cover the original cell area (Lee, 1989). Or the original cell site can be retained, but new cell sites set up around the perimeter of the original cell. Calhoun (1988) and Lee (1989) suggest the use of microcells, which are small cells within a larger one called the macrocell, designed to cover specific areas of high density traffic. Smaller cells (except when used to cover a sector) will mean lower power levels to avoid interference and maintain cell separation.

Splitting has limits and may not lower costs, according to Calhoun. He notes that each new cell site costs approximately as much as the original one, so cell site costs will vary directly with the number of sites. Cell-splitting may actually be more expensive than the original installation, Calhoun argues, because splitting is most likely to be necessary in congested urban areas where site location and construction costs may be highest. In addition, the increased number of sites will increase the number of handoffs per call, adding substantially to the processing load for the MTSO. The proliferation of new cells plus additional users will exhaust the capacity of the MTSO, he argues, and the cost of adding capacity could be higher per additional user than the cost of the original system.

History of the FCC Decision

American Telephone & Telegraph was one of the pioneers in mobile telephone, starting the first service connected with the PSTN in 1946 (Calhoun, 1988). Use of mobile telephones and pagers burgeoned, and in 1949 the FCC recognized land mobile radio, as it was officially called, as a new class of users. Joining AT&T in the new industry, called radio common carriers or RCCs, were a large group of mainly small

companies, which offered radiotelephone and paging services. In 1968, according to Hardman (1982), there were 500 RCCs serving 28,000 mobile telephone units, about 42 percent of the U.S. market. AT&T realized that available spectrum for mobile telephone use was inadequate to meet the demand, so the company made a series of requests to the FCC for more spectrum, which of course would have to come at the expense of broadcasting. From the late 1940s, broadcasters and private radio interests battled over spectrum allocation.

Not until 1967 did the FCC indicate a willingness to reallocate some of the little-used UHF television band to the growing mobile radio industry. A House of Representatives committee in 1968 called for the allocation of more spectrum to mobile radio and telephones, and a presidential task force the same year came to a similar conclusion (Calhoun, 1988).

The battle was joined, but far from over. The FCC in 1968 started two rule-making procedures regarding cellular's future: Docket 18261 and Docket 18262. Docket 18261 asked for comments on a proposal to share all UHF channels with mobile radio services, and 18262 proposed a reallocation of UHF channels 70-83 to mobile radio use. The proceedings have been called "one of the most contentious in FCC history" (Calhoun, 1988, p. 48). More than 110 parties filed comments, and 40 parties were heard in two days of hearings. The battle pitted the broadcasters, who argued they had future needs for currently unused spectrum, against the mobile radio interests, led by AT&T. On a 3-2 vote, the commission decided that mobile radio needed more spectrum, but it was two years before the FCC issued the order reallocating it. Mobile radio won 115 more MHz for mobile services, including 75 MHz (later scaled back to 40) for mobile telephones (Calhoun, 1988).

The FCC order of 1970 gave the new spectrum to mobile telephone, but said nothing about how the directive was going to be implemented. That took another 12 years and a great deal of legal and political maneuvering. The Band 806-890 decision

of 1970 makes it clear that the FCC assumed that AT&T--the "phone company"--was the logical organization to set up and operate radiotelephone systems. Many thought that each market would have only one mobile telephone supplier. The giant seemed like the only one with both the financial strength and technical expertise to do it, and it was not illogical to conclude that mobile phones were just an extension of AT&T's natural monopoly.

Despite its size, however, AT&T was only half of the radio common carrier industry. The other half was the agglomeration of more than 500 radio service suppliers, the RCCs, and they served about half of all customers using radio common carrier services. The RCCs already had the use of radio spectrum for their services, and they were not about to give it up easily. And although they were technically eligible to apply for licenses for mobile phone service, when the application process was opened, few expected the RCCs to get a significant number of licenses competing against AT&T. (Calhoun, 1988).

The RCCs took to the courts. At first, Motorola, the main manufacturer of radiotelephone equipment, sided with AT&T. However, AT&T apparently committed a tactical blunder. In its proposal to set up a test system in Chicago, AT&T went to other suppliers for equipment. Motorola quickly changed sides and supported the RCCs in their bid to get a piece of the pie. Motorola also worked with one of the larger RCCs on an application to set up a prototype cellular system in the Washington, DC, area (Calhoun, 1988).

The RCC industry, long a business of small firms with limited technical and financial resources, was changing. The paging business, the RCCs' bread and butter, went from 50,000 users in 1970 to more than 600,000 in 1978 (Hardman, 1982). Despite its fragmentation, the RCC industry served a substantial portion of the radiotelephone market. New technology and equipment was being developed by vendors which would make it easier for RCCs to set up their own systems. The RCCs

were gaining stature in the financial community, giving them access to the capital needed for such expansion (Calhoun, 1988).

The regulatory climate was changing as well. More attention was being given to promoting competition instead of allowing benign, regulated monopoly. The Justice Department was pressing for open entry into the new mobile telephone field in the interest of competition. The RCCs obtained an appellate court opinion which admonished the FCC for seeming to favor more AT&T monopoly (Calhoun, 1988).

After more than a decade of lobbying, pressuring, litigating and verbal jousting, the issue was finally settled by the FCC in 1982 (Cellular Communications Systems (modified), 1982). Each mobile telephone market would be split down the middle, with two license holders sharing the spectrum. Preference would be given to the local wireline phone company for one license, with the other to be awarded through the normal FCC licensing procedure (Calhoun, 1988).

Davis (1988) reports comments from the U. S. Court of Appeals and a congressional inquiry which could have influenced the FCC to consider competition at the local level. Hardman (1982), gives more of the credit to changing conditions in the RCC industry, which made it probable that many RCCs would challenge wireline applications to offer the exclusive service. He notes that hearings could last for years, and that for antitrust reasons, it would look bad for the FCC to award too many markets to AT&T. Calhoun (1988) accepts the thrust of Hardman's argument, adding that the FCC saw the two-operator solution as a way of streamlining the applications process, since the local wireline company would be an easy choice for one slot. He also notes that by the 1980s, the FCC was much more inclined to foster competition than it had been a decade earlier. Thus, the cellular telephone industry was created with a duopoly market structure endorsed almost coincidentally by the Federal Communications Commission.

Perspectives on Policy

Any study of public policy should have a broad perspective. In a democratic society, there is a vast array of constituencies and viewpoints. While not all can be equally served, all deserve to have their interests considered. To accommodate such a variety of needs and voices, various approaches have been used. Two of the most popular approaches to public policy debate have been labeled the market economics and social value schools, or just "market" and "social" by Entman and Wildman (1990). They contend that public policy debates tend to have a circular nature, because adherents of the two schools do not address each other.

The market school, in their lexicon, is composed of analysts who favor an economics approach. They favor allocation of resources according to willingness to pay, with the primary objective of economic efficiency. Market-oriented analysts also presume that encouraging competition, which allows individuals to exercise their preferences, is the best means of assuring efficiency.

The social school, as defined by Entman and Wildman, is more concerned with possible positive and negative effects upon society. Maximization of social welfare is the primary objective, and in the short-run at least, individual choice may not further that objective. Implicit in the social approach is the belief that government or some other institution may be superior to the market in directing allocation of resources for the social good. The social school adherents, according to Entman and Wilder, tend to focus on the negative social effects of the market approach.

Perhaps Entman and Wildman make an unduly harsh characterization of the market school in their interpretation that it rests solely on economic efficiency. Increasingly, economists are considering issues of equity to temper their analyses. Although the social school emphasizes nonmonetary aspects of policy, these still have economic implications in terms of resource allocation impacts. There can be little doubt, however, that the deregulation trend of the past decade has swung the policy

pendulum toward the market school and away from the social value approach which dominated for many decades.

The groundbreaking work of Becker (1965, 1976), Fleisher and Kneisner (1980), and others has demonstrated that analytical techniques of economics can be applied to situations outside the conventional market economy. Cultural value-related preferences can be modeled and analyzed. Behavior far beyond that of traditional market participants may be analyzed and explained. Although this paper will not attempt anything that sophisticated, other social sciences have been using comparable techniques to some degree.

Studying Media through Economics

For the communications scholar, the choices of topics and approaches have multiplied. Mass communication scholarship is no longer limited to the traditional mass media forms. To confine scholarship to newspapers, television and the like is to overlook vast developing areas of the communication spectrum. Mass communication scholars need to define their world of investigation much more broadly to include media and channels which offer alternatives to the traditional ones.

Scholarly approaches in mass communication are being broadened. Media effects researchers, who predominated for the last half century, have focused on effects to audiences and society. The theories and paradigms used in this research have their roots primarily in psychology, political science and sociology. Others have studied the mass media from the perspective of the law or history, two old and honorable academic disciplines. Critical theorists, stemming from a European tradition, have become more active in American scholarship. Relatively few media researchers have approached the field through the paradigm of economics, although in recent years that small group of researchers has gained some visibility.

Economics has certain advantages over other approaches to mass media studies. Economic theory has been developing over a period of two centuries. There is probably more consensus among economists concerning paradigm and theory than in most social sciences. Although interpretations often vary, the explanatory power of economics is widely accepted. Because the discipline is well-developed, operationalization may be less of a problem than in other communications studies paradigms.

Data for empirical use are available from various public and private sources. Much of it is in forms, often monetary, which are easily compared with data collected by other organizations or at other times. Most of the data represent results of behavior (purchases, manufacturing, etc.). In this sense, the data can be regarded as operationalization of behavior patterns. The values expressed in currency may also be regarded as indicators of value to individual consumers and to a society. The case can be made, for instance, that American society places a much higher value on television than on radio, because both consumers and advertisers spend far more dollars on television.

One of the advantages of economic data over data commonly gathered and utilized in other social sciences is the fact that most of it is aggregate, comprehensive data, not inferential data based on sampling. Very accurate figures are readily available, for instance, on how many newspapers are sold daily; so in many cases we don't have to project the numbers based on sampling and statistics.

This is not to say that economics does not have limitations. Economics takes individual preferences as a given, so it is not necessarily concerned with motivations. Therefore, care should be taken not to make unfounded inferences about motivations based on economic behavior. Economics studies what people really do as they make their choices based on preferences, not what they say they prefer or value. Patterns and relationships can be documented through the study of economic behavior which can

contribute substantially to the understanding of what is happening within an economic system. Such is the spirit in which economics is used in this paper.

Economics focuses on group and societal behavior, not the stated reasons for that behavior. Within the paradigm, economic phenomena have an existence of their own, beyond the underlying actions of individuals and firms. The phenomena have reasons and results which lie within the economic sphere, apart from reasons and results of individual decision and actions.

Tullock and McKenzie (1985) note that the term economics is applied to both a set of research tools used by economists and a rather poorly defined area of research interest. They argue that the methods of economic research can be applied to much broader areas of human behavior than has traditionally been done. This approach is expanding the traditional areas of economics study, encroaching on the other social sciences. This broadening of research methods and areas of application is not unlike the expansion of paradigms in the communications discipline. The methods of economics, as well as its underlying assumptions, can serve as useful additions to the paradigms and analytical tools previously used in communications.

Economics forms a useful and powerful paradigm to study large arrays of decisions and behaviors. Various economic behaviors are highly interrelated, and the discipline is sophisticated enough to provide a structure for many of these relationships as well as offer explanatory power. Economic behavior can often be related to behavioral studies in other paradigms. Thus, the act of casting a ballot, for instance, may be viewed as a political act, a psychological act, a communication act, or an economic act. These paradigms and others can be used to study the electoral process, and each one yields its own insights.

Many communication acts can be viewed as economic acts as well: the choice of a communications channel; the consumption of information; the offering of a service or product. These acts can be defined, observed and expressed in economic data.

Economists study the allocation of resources. Acts of resource allocation constitute behavior, and economics can do an effective job of identifying and tracking relevant behaviors. The data are also available to aggregate many of these behaviors and study them for patterns. Dollars are spent, resources are purchased (allocated), other demanders who bid less get by with fewer resources or none at all. Some of the resources become inputs for yet other resources, leading to another set of behaviors.

Economists have traditionally been concerned primarily with the "efficient" allocation of resources within an economic system. Efficiency refers to the ability to allocate resources to maximize utility to participants in the system. A market is considered efficient if it maximizes the utility yielded by the available resources.

Zajac (1978) argues that allocative efficiency and social fairness are in tension. "As always, one must bear in mind the inherent conflict between economic efficiency, which satisfies a very minimum criterion of economic justice, and other possible justice or fairness viewpoints. In particular, it is easy in pursuing some superficially attractive economic justice idea to undermine economic efficiency" (Zajac, 1978, p. 105).

Wolf (1988) suggests that the additional objective of distributional equity should be considered by economists and policy makers who use economic analysis. He argues that in the world of public policy, issues of distributional equity are more influential than economic efficiency. Wolf acknowledges, however, that economists are not comfortable with distributional issues, and lack the precise tools of microeconomics to deal with them. He also admits that the term equity is used in a variety of meanings, and the resulting ambiguities influence the decision-making standards and process.

In recent decades, economists have employed such approaches as welfare economics and social choice theory to attempt to deal with distributional issues. Wolf posits that free markets are best suited to dealing with efficiency (allocative) issues, while governments are better suited to dealing with distributional equity issues.

Commenting specifically on public utilities, he suggests that a combination of the two is likely to yield the most acceptable results.

Any act that results in a record of an economic transaction is potentially reflected in a data set. Such records give economics an advantage over other social sciences, in which records are normally not kept except for research purposes. The problems of data collection and verification are much simplified, because the data are being collected for other purposes.

Economic data are analyzed to determine patterns, which in turn represent behavior. These patterns make it possible for economists and communications scholars to develop theory, which should have explanatory and possibly predictive power. So the paradigm of economics provides the framework within which explanatory and predictive theory might be formulated.

Marriage of Disciplines

So why this marriage of economics and communications? Communications is a field of study, but not a neatly defined academic discipline. At present, it has no single paradigm or consensus on how to approach its study. Indeed, the communications "community" cannot even decide whether communications is a transmission of mathematically definable signals through channels (Shannon & Weaver, 1949), a group of acts related to linguistics (Cherry, 1959), or a process (DeFleur & Ball-Rokeach, 1982). Clearly, it is all of these and more, and no paradigm has been formulated to include such widely disparate viewpoints.

Economics can be regarded as a paradigm--an approach of scholarly study. It is applied to many subject areas--from government to consumer behavior. Any industry can be viewed through the paradigm of economics. Economics has traditionally delimited itself quite clearly and sharply. Thus, it stops short of trying to determine, much less explain, motives of consumers. Traditionally, it has ascribed to consumers

the rational objective of maximizing utility. This is a tidy boundary, if not always realistic, because it is up to the individual consumer to define and ascertain what utility is, and thus what constitutes maximization of it.

For the firm (any producer or provider of economic goods), the traditional objective is assumed to be profit maximization. Although the usual approach is to define and measure profits in terms of dollars or other national currency, it is possible that some of the profits (rewards) are in other forms, such as security and prestige for the members of the firm and the survival of the firm itself. As with the consumer, it may not be important to the economic study of firm behavior just what the motives are. If we are interested in outcomes, the reasons for the underlying actions may be immaterial.

As noted earlier, economic data create a trail which can be used to track behavior, such like the use of communication channels. Similarly, economic theory may be useful in explaining and predicting behavior that constitutes communication. Thus, the tools of economics prove to be applicable and practical for the study of communication channels.

Cellular Telephone Markets

When the Federal Communications Commission created the cellular telephone industry, it adopted an unprecedented and unique policy in regard to market structure. In each of the first 305 cellular telephone markets, the FCC decreed that there would be two firms licensed to offer cellular service. Never before in the history of American utility or telecommunications regulation had such a market structure been adopted as a matter of national public policy.

Duopoly market structure, as the two-supplier pattern is termed by economists, is frequently used as a model for theoretical work in economics, yet it is infrequently encountered in the real world. As a model, economists often utilize duopoly as a

simplified representation of oligopoly, to introduce the element of competition. Thus, the modeling decision is bipolar: monopoly or not monopoly. If the model is to be nonmonopolistic, duopoly is the simplest structure.

Whether duopoly represents effective competition is a question that has not received a lot of analytical attention. Perhaps this is because economists are aware that duopoly is a simplification, not a common real world situation, other than occasionally in some local markets. It also may be related to the fact that since few pure duopolies can be isolated, empirical studies have been rare.

Evidence of Competition

Standard evidence of a functioning competitive market would be the steady movement of price toward marginal cost. While we may speculate about declining costs or economies of scale and scope, accurate cost data are difficult to obtain in the cellular industry. Perhaps precisely because the duopoly structure creates at least the appearance of strenuous, head-to-head competition, managers play their hands close to the vest and maintain their information in proprietary fashion.

In the absence of cost data, we must look to other evidence to indicate whether or not meaningful competition exists. The following can be considered indicators of competition in a duopoly market:

1. The general trend in prices

In the early operational stage of any cellular telephone system, there are strong economies of scale as the system grows. This is because a substantial investment in plant and equipment must be made before a system goes on the air. As these high fixed costs are spread across an expanding customer base, marginal costs are low and average costs are declining. This trend will continue at least up to the point where usage bumps against capacity at peak use times in high volume cells. At this point, management

must make an assessment as to what constitutes an acceptable level of calls blocked due to a shortage of circuits. If the competitor still has excess capacity in the cells where high blocking levels occur, the vendor at full capacity may stand to lose business.

Even at the point where blocking is unacceptably high in certain cells at peak times, the firm with more customers may enjoy economies of scale. The switching capacity of the system, a major component, may well support more cells and more calls. Cell division and microcells may offer expansion at less cost per channel than a totally new system, although Calhoun (1988) argues that this is not necessarily so.

2. Disparity in prices between competitors

Price differentials indicate that one firm sets a price or prices lower than the other in order to gain market share. Disparity may be difficult to assess, however, in terms of both competition and services offered. A low-cost competitor may be cream-skimming the market. One vendor may be operating at capacity or otherwise constrained, and the competition taking advantage of the unmet demand. Disparity may be an indication that the market is unevenly divided, and that the higher-price competitor is less concerned about losing market share. Differences in quality or nature of service, or reputations of the vendors, may give the high-priced competitor a market edge which permits it to charge more.

In the case of cellular, the service offers rather limited opportunities for quality differentiation. In some markets, one competitor may have more or better-placed transmitters, giving it better transmission quality or coverage. Cellular technology, however, permits an operator to add or split cells to close that quality gap. Since many of the technical constraints and requirements are set by the FCC, vendors are fairly limited in regard to service quality. Adams (1990) reports that claims of superior quality usually were based on customer service and customer equipment, not on technical considerations of cellular transmission and reception.

A continued price gap indicates that at least one firm considers itself engaged in serious price competition with the other. If that were not the case, the less dominant firm in the market simply would be a price-taker--accepting the price levels of the dominant firm, whether higher or lower. If the disparity continues and the overall price trend is downward, it is strong indication that the duopoly market is indeed strongly competitive.

3. Multiple pricing strategies.

Price discrimination is the practice of charging different prices to different market groups. Applying the economic view of price differentiation, different classes of customers are identified and sustained because they exhibit variations in the elasticity of their demand curves. A multiple pricing strategy may indicate an effort to maintain profit margins in the face of downward pressure on prices, or to take advantage of variations in demand elasticity. Because cellular prices usually consist of a fixed monthly access fee and a variable usage charge, the discrimination principle may be applied to either or both components. The two components fit in such a way that they can be manipulated inversely to strengthen differentiation. A common application, often reflected in cellular pricing schemes, is to offer lower prices or discounts to volume users. These lower rates, however, are often coupled with higher access charges. This practice is an indicator of competitive behavior. Higher volume packages often include some airtime in the fixed fee. Variation can occur in either segment of the price--the access fee or the variable portion based on volume of use.

The system effectively allows--indeed requires--users to self-select according to their predicted usage patterns. Subscribers who expect their usage to be low will choose a plan with a relatively low access charge, but be subject to higher per-minute charges. High volume users will opt for a lower per-minute price, even if it entails a

higher access charge. Many vendors offer several combinations of charges, to subdivide the market into segments.

Multipart pricing, even if practiced in a monopoly or low competitive situation, can increase market efficiency. If a firm can successfully defend higher prices in segments of the market with inelastic demand, and offer lower prices to more elastic segments, it can satisfy more of the total demand. Total surplus can be expected to be greater than it might be under a flat pricing regime, because more customers can be served than is possible with a sustained flat rate. However, if the strategy is successful on the part of the vendor, the effect is likely to be a reduction in surplus for some consumer segments, and an increase in corresponding producer surplus, or a shift in surplus from one consumer group to another.

Price discrimination can be expected to be more difficult to sustain in a competitive market than one in which producers collude, even tacitly. Increased competition will create more purchase options for market segments with less elastic demand curves, and higher prices, and these segments may be offered lower prices by other vendors. This in turn would increase consumer surplus for such segments at the expense of producer surplus, but reduce the ability of vendors to offer the lowest possible prices to marginal consumers low in the demand curve. Discriminatory pricing, especially if applied in similar fashion by both cellular operators in a market, may be an indication not of competition, but of a strategy to extract higher prices from customers who have relatively inelastic demand.

4. The addition of special features to enhance the service.

Product differentiation is the classic marketing strategy to distance a producer from its competitors and enable it to charge higher prices or secure market share. In the case of products which are essentially commodities, like laundry detergents or gasolines, small, nonessential or nonexistent differences may be promoted by heavy

advertising, creating the perception of substantial differences on the part of consumers. Features in cellular telephone may include such enhancements as call forwarding, voice mail, call waiting and special billing. It is unclear to what extent these enhancements should be considered "demand-pull" or "technology-push" changes. What is clear is that they are relatively low-cost improvements, yet they may be significant to some customers.

5. A pattern of reaction to each other's downward price adjustments, or unwillingness to follow price increases by the competitor.

If a firm adjusts prices and the competitor follows, market leadership is indicated. If a leader raises prices and the competitor follows, the second firm is a price taker, and the action is not indicative of competition. However, if the price adjustment is downward, competition may be indicated. Similarly, if a firm raises prices and the other fails to follow, competition is indicated. If one firm has a special promotion, using lower prices or a bonus of some sort to attract new customers, the action can be interpreted as a competitive tactic in the same way as a longer term price reduction.

6. A pattern of the prices charged by the higher price competitor moving toward the lower prices of the other firm.

This is the obverse of the pattern described in #5 above. Instead of the price leader taking the initiative to either reduce prices or hold them against increases, this pattern indicates that a would-be price leader who would prefer higher prices is unable to make them stick. This in turn is evidence that neither firm has the market power to assert strong price leadership and therefore an indication that competitive conditions are present.

7. Frequent changes in price structure.

Frequency of price adjustments is an indicator of managerial activity to find ways to either attract new customers or respond to competitors' initiatives. It may not be possible to conclusively impute motives. Another explanation in some instances might be management's attempts to broaden the market, not necessarily with competition in mind. However, motives are less important than behavior in assessing the market impact. If the result favors the consumer, regardless of the firm's motive, market structure has accomplished a result compatible with competition.

Other factors, of course, may have an impact on price behavior in a single cellular market, particularly the following:

1. Price levels in that market relative to other markets. In particular, if prices are lower than the average nationwide for comparable markets, operators may feel that there is room to raise prices and remain acceptable. In this young industry, pricing was apparently a search process, and new firms went through a learning period to determine regions of acceptable rates. In January 1986, prices in the Buffalo market were among the lowest in a major market. Over the next five years, Buffalo prices trended upward at the same time that price reductions were common in many other markets.

2. Cross-ownership of franchises in more than one market. Because wireline companies are often regional in nature, we can expect many of the wireline operators in a state or region to have similar price structures. The same may occur with nationwide firms which own more than one franchise. Increasingly, the non-wireline operations are owned by large operators, often wireline firms from other regions. In the top 30 markets, the company with the most non-wireline systems in 1991 was McCaw Cellular with eight non-wireline licenses. Next was Southwestern Bell, with four non-wireline systems. PacTel operated two non-wireline systems in the top 30 markets. Both Southwestern Bell and PacTel operate wireline cellular systems in their regional market areas.

3. Whether the market, or sections of it, is approaching its cellular calling capacity. Although cellular capacity can be expanded readily by cell-splitting in many cases, this technique involves a substantial investment in new transmitting equipment. Management may opt to raise prices and retard growth until capacity is expanded or the competing firm encounters the same capacity problem. In an environment of technological change, management may also opt to retard growth until digital technology is adopted, thus alleviating the shortage of spectrum without the construction of new cell sites. In 1991, the industry was in the throes of a debate over the adoption of a digital standard, and firms may have been delaying expansion plans until a standard emerged.

Research Problem

Cellular telephone is a service offered to the general public provided by private vendors. Because it uses the electromagnetic spectrum and certain types of facilities which have long been regulated, the industry exists in its present form by directive of the Federal Communications Commission. The FCC is charged with the task of regulating specific communication industries in the public interest. At least by implication, certain public policy objectives are used as guidelines for FCC decisions.

The study will address two questions:

1. To what degree has the duopoly local structure of the cellular telephone industry resulted in competition?
2. How well has the level of competition thus achieved met the public policy objectives of regulation?

Definitions and Concepts

To effectively address these questions, some terms and concepts should be specified.

Duopoly

Duopoly is a market structure in which two firms and only two firms supply the good or service. Although it is difficult to eliminate potential substitution of similar goods, the product must be carefully enough delimited so that the supplying of it can be considered an industry or distinct line of business. Geographic and other limits on potential customers and suppliers must also be clearly recognizable.

Competition

Competition is the state where two or more firms are actively trying to win business in the same market. Logically, competition does not take place when firms are colluding, either overtly or tacitly. Competition itself is an abstract and therefore neither tangible nor measurable. However, competitive behavior (rivalry) is observable, and both the behavior and the results of competition may be measurable.

Economists have developed a detailed typology of models of competition, as well as the expected behavior from the sustained existence of each model. The following synopsis of competitive structures and the predicted behavior is drawn largely from Bolter, McConnaughey, and Kelsey (1990).

The basic standard for competition is pure or perfect competition. This is defined as a market with a homogeneous product where no single producer or single consumer is large enough to have any impact on price. From each producer's perspective, demand is beyond his ability to fill at the market price. However, if the producer attempts to sell above market price, his market share will be supplied by another producer. Assumptions include free entry to and exit from the market, the goal of profit maximization, and no government regulation.

Under perfect competition, the long-run price will eventually settle at the marginal cost of production, including a normal return on investment.

At the other end of the competition spectrum is monopoly. In this situation, there is but a single producer of the good, and no substitute for the good. Thus the monopolist controls both supply and price, and is limited only by the product demand curve, which is presumed to be downward-sloping. Barriers preclude the entry of potential competitors.

The monopolistic firm will maximize its profits by producing at the point where marginal cost equals marginal revenue. However, unlike perfect competition, the price will not be set at the point where marginal cost equals demand. If the firm attempts to sell more product, the revenue from the next sale will be less than the cost of making that quantity, and therefore total profit will be reduced. This point of maximum profits is not the point at which social welfare is maximized. If price were to move downward, toward the level where demand (price) equals marginal cost, more of the good would be sold and more consumer surplus created, thus increasing total welfare. This, of course, would reduce the monopolist's total profits.

Although the range from pure competition to monopoly is a continuum, economists commonly delineate two intermediate segments (sometimes more) for separate treatment: oligopoly and monopolistic competition. Oligopoly is the condition where a relatively small number of supplier firms constitute or dominate a market. This creates a considerably more complex problem for analysis, because of the need to determine how decisions are made within the dynamics of interdependent firms.

The pricing pattern under oligopoly is harder to predict. Several well-known models have been developed to fit variations of oligopoly. Some theorists have assumed a degree of collusion in price-setting, or at least price leadership by the dominant firm. However, no price-indicating model seems to take into account all the variations. Prices are generally higher than under monopolistic competition and lower than monopoly. There is no consensus as to the social welfare benefits (Bolter et al., 1990).

Monopolistic competition exists in a market where there are a relatively large number of firms producing differentiated but competitive products. On the continuum of competition, monopolistic competition is closer to perfect competition than oligopoly. Long-run prices will be set at average cost, but above marginal cost.

A special situation of oligopoly is duopoly--the market with only two producers. Economists frequently use a duopoly model to analyze and test theories about oligopolies. The Federal Communications Commission has mandated that cellular telephone service areas each be served by no more than two competing firms, thus creating several hundred neatly circumscribed duopolies.

Natural Monopoly

A natural monopoly, as currently defined, is a market where subadditivity of costs makes it more efficient for a single supplier to meet total demand than any combination of two or more suppliers, over the relevant range of demand (Berg & Tschirhart, 1988). Subadditivity is the attribute that the firm's costs are either decreasing due to economies of scope and scale, or increasing at a rate less than would be the case with any combination of two or more firms.

This is a refinement of the more traditional definition, which sees natural monopoly as the situation where a single firm can supply the market at lower cost due solely to economies of scale. Berg and Tschirhart refer to the traditional definition as a strong natural monopoly. A firm whose costs are subadditive but do not decrease over the entire relevant range due to economies of scale is labeled a weak natural monopoly (Berg & Tschirhart, 1988).

Public Interest

Public interest and public policy are very vague terms. Presumably law and regulatory practice are pursuing the public interest by deciding and implementing public

policy. Although there can be no universal consensus, communications regulatory practice in the U. S. has developed several widely recognized objectives, which will be discussed more fully in Chapter 2. Any public policy, by its nature, will favor certain groups and goals over others. Much of the debate over public policy involves different constituencies, possibly with equally high needs and motives, who stand to gain or lose benefits under various regimes. Politically, regulatory agencies must reconcile opposing groups and policies and make decisions which will maximize benefits to the public. Alternatively, political processes can be viewed as maximizing the probability of retaining or obtaining power.

Information

All communication is exchange of information, by a common definition. Information is often conceptualized in far more restrictive ways, however, and experts offer a variety of opinions when they attempt to define the term. The significance of the term, as Compaine (1981) sees it, is that the view of information has a great impact on criteria for policy-making. Braman (1989) expresses a similar caveat, noting that conflicting regimes of regulation and policy are anchored in conflicting definitions of information.²

In probably the most thorough treatise to date on the definition of information, Braman identifies four perspectives from which information is commonly defined. She argues that no single perspective serves all purposes. Indeed, she posits that the adoption of a particular definition or even perspective is in effect a political statement, because of the resulting influence on policy debates. The perspectives identified by Braman are:

Information as a resource. Definitions in this class are commonly used in economics and mass communication. The concept is uncomplicated. It can be operationalized in a quantifiable manner,³ and it emphasizes the use people make of

information, rather than the effect of the information. The resource definitions imply that information can be processed.

Information as a commodity. This could be seen as a subclass of the resource approach. It is often used when referring to large quantities of information or data, which are commercially traded. The definition, however, can be used to exclude certain kinds of information not generally regarded as commodities. The definition lends itself well to application in economics.

Information as perception of pattern. This class of definitions adds context to the perceptual mix. Thus, information has a past and future, is affected by motive and other environmental and causal factors, and itself has effects. Braman places the Shannon and Weaver, Stigler, and Machlup approaches in this class. Perception of pattern widens the context and comes closer to the real world setting of information creation, processing, flows and use. A serious problem is that perception of pattern and context differ from observer to observer, thus making such definitions difficult to use for policy making or quantification.

Information as a constitutive force in society. This class broadens the meaning to recognize that information shapes its context, as well as being shaped by it. This increases the variety of applications to fields like cybernetics, social psychology and diverse political perspectives. This approach has strong implications for policy making. A decision about information policy is necessarily a decision about the desired structure of society. The big drawback is the difficulty in quantifying events and effects related to information when thus defined.

Braman suggests that the choice of definition rests on three factors:

1. The perspective from which one views the public policy issue.
2. The utility of the definition for a particular situation.
3. The relationship between the definition and the notions of power with which it is associated.

Braman concludes that for policy-making purposes, all levels of definitions should be used, working from the broadest (constitutive force) down to the narrowest (resource).

Since we are concerned with economic analysis of technologies that transmit or process information, we shall make several stipulations for this study:

1. Although it is undeniable that information can and does shape the very environment in which it exists and is processed, economics models and perspectives are not yet advanced enough to include the effects of information on the environment. Therefore, such definitions are too broad to be helpful in our consideration of communication technologies.

2. Perception of pattern is a useful, fairly specific way of looking at information, and a valid one. It is consistent with most economic, engineering and communications definitions, and not impossible to operationalize. It is not mutually exclusive with the first two, more simplistic, definitional classes.

3. The term resource would seem to subsume the commodity approach. From the economics perspective, all commodities are resources, yet all resources may not have the attributes of commodities. Commodity would appear to describe particular attributes, rather than specifically defining a class of information.

4. Therefore information will be defined as data that have been organized in such patterns that it becomes meaningful and useful. It may be represented by the value that it creates for the user. This is subjective, but it is measurable at both the individual and societal level.

Consumer Surplus

Consumer surplus is considered to be the difference between what a consumer has to pay for a good and the maximum price he would be willing to pay, which is dependent on his perceived utility. Or as Hicks (1969) quotes Marshall: "the excess of

the price which he would be willing to pay rather than go without the thing, over that which he actually does pay".³

In graphic form, consumer surplus or CS is represented by the area of the triangle below and to the left of the demand (D) curve, and above the line, often shown as horizontal, of the market price (P). This is the visual depiction of Marshall's definition.⁴

Organization of the Study

Chapter 2 of this study reviews relevant literature and theory in communications and economics. The communications section concentrates on theory which explains the uses of communications channels and technologies with implications for telephone-like technologies. The economics review surveys the applicable analytical tools of microeconomics, and economic commentaries on telephone and cellular telephone. Because both wire-based and radio-based telephony are subject to regulatory control in the United States, the chapter concludes with an overview of regulatory theory.

Chapter 3 develops the study methodology. Theory suggests four types of competitive behavior which may be examined using the available data set. These behaviors are operationalized and the framework established for the analysis of the behavioral characteristics. The data are analyzed according to the methodology and the results shown in Appendices B through I.

Chapter 4, Section 1 examines the results of the data analysis and draws conclusions regarding the first research question. Section 2 discusses the results in terms of public policy objectives, giving special attention to competition, price structures and trends, regulatory constraints, and effects of technological evolution, then draws conclusions on the second research question.

Chapter 5 summarizes conclusions and suggests further avenues of research.

Notes

¹ Some exceptions stand out: See Pool (1977, 1983, and 1990), Short, Reid and other British researchers of the 1970s, Rakow (1992), and O'Keefe and Sulanowski (1992).

² Information is a central concept to the study of new media technologies. Author after author uses the word information, assuming that readers and scholars share a common understanding of the term. Various authorities refer to the information age (Schramm, 1988), information processing (Caron, Giroux & Douzou, 1989), information business (Compaine, 1981), information industry (Chisman, 1982) and numerous other terms and phrases incorporating the word information. Yet it is clear that scholars have widely divergent concepts when they use the term.

Zorkoczy (1982) suggests that information has so many diverse definitions because it is intangible. Since it is encountered only operationally, it is known only through its subjective effects.

Compaine (1981) sees the concepts of information on a continuum ranging from commodity to theoretical concept. He suggests that information actually has attributes from each end of the scale. From an economist's perspective, Compaine discusses the "production" of knowledge comparable to any other economic activity.

Stigler (1961) uses information and knowledge as synonyms. Machlup (1980) inveighs against drawing a distinction between information and knowledge. He argues that information is contained within the concept of knowledge, but leaves open the possibility that the opposite may not be true. However, he appears to use a rather limited concept of knowledge that linguists would say is incomplete, as it ignores the related issues of understanding, comprehension and insight.

Bell (1979) uses information to refer to data which are stored, retrieved and processed, which he says is the essential resource for economic and social exchanges. Knowledge, on the other hand, is organized sets of facts or ideas. Knowledge requires new judgments, in Bell's view, distinguishing it from mere news or entertainment.

Bell also argues that the concept of commodity is not applicable to information. Commodities, he says, are produced in discrete, identifiable units, which can be exchanged, sold, consumed and used up. Information, however, remains with the producer even after it is sold, and thus can be available to all. This suggests that it has the nature of a public good.

White (1982) agrees that information is a public good, noting that information can be sold or given away and at the same time remain in the possession of the producer or vendor. This public good property, however, creates some problems in a society which is based on private ownership. Because of this, the system of copyrights and patents has been developed to encourage the creation of information by creating a time-limited property right.

Lewin (1981) takes issue with White's implication that, for the owner or vendor, information is unchanged when it is sold or given away. He argues that information takes its value from its timeliness, relevance and relative confidentiality. All three factors can change, of course, but the confidentiality factor can be eroded by dissemination and low pricing.

Zorkoczy comments that information is derived from data, which may be restated to say that information is data that has been arranged or interpreted in a fashion to have meaning to a user.

Information is reduced to mathematical notation in the system pioneered by Shannon and Weaver (1949). They caution that the term information, as used in the Shannon theory, is independent of semantic aspects. Information, as they use the term, is strictly the reduction of uncertainty. This is an elegant definition for both conceptual and technological purposes, but it is very specific and restricted in its application. It lends itself to quantification, because the amount of information in a message can be expressed by the logarithm of the number of available alternatives. They also introduce the notion of varying probability among possible choices. Both of these characteristics--reduction of uncertainty and probability--can be nicely handled mathematically. Since under their definition information can be quantified, such attributes as volume, speed and capacity of information manipulation and transmission can be readily measured. The Shannon and Weaver mathematical definition has become part of the engineering approach, which states, "The information contained in a message unit is defined in terms of the average number of digits required to encode it." (McGraw-Hill, 1977). This definition appears to ignore any distinction between information and data.

Consistent with the Shannon and Weaver definition, but very different in its application, is that of Bateson (1979): "Any difference which makes a difference." The first "difference" can be interpreted as choice, and the second is comparable to "reduction of uncertainty". Bateson's definition, however, does not lend itself to quantification and thus, to measurement, so it is of limited value in analyzing communications technologies.

The foregoing definitions assume that the information exists independent of who or what is using it. Those who study communication as semiotics see the issue very differently. They see information as the recipient sees it. That is, the receiver of information has his own interpretation. The main concern of semiotics is the transmission of meaning. Semiotics scholars are concerned primarily with three aspects of communication: signs, the codes or systems into which signs are organized, and the culture within which these signs and codes operate (Fiske, 1982). The interpretation may be quite different than the intention of the initiator of the communication containing the information. Strictly speaking, every human recipient has a unique interpretation because of differences in background, perspective, etc. Therefore, all communicated information is different depending on the recipient.

Bell (1979) points out that the Shannon model of information is not generally appropriate for economic analysis, because it gives no weight to the value of the information. Each information recipient must determine its value for his own purposes before economists find the concept useful.

On a more pragmatic level, most of the foregoing definitions also assume that information exists independently of the package or format by which it is presented. The consumer, however, purchases the package and not, generally speaking, the information (Berry, 1989). McLuhan (1964) takes a nearly opposite view—that information and the medium by which it is transmitted and presented are inextricably entwined to produce meaning.

The semiotics view is that information cannot exist independent of its context—be it a medium or an electronic or human processor. A message is changed into a new message in the very act of encoding, transmitting, decoding or perceiving (interpreting) it. Thus, information is transformed at every point in a process of manipulation or transmission, so it is futile to attempt to measure or even capture it.

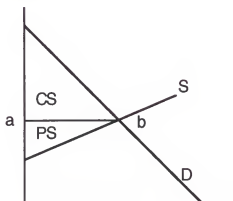
Linguists have wrestled with the problem of defining information, without finding a consensus. One linguist points out that most connotations of information rest on the idea of selection power (Cherry, 1959). Selection can be viewed as the exclusion of other possibilities, which is not unlike Shannon and Weaver's definition of information as the reduction of uncertainty.

Zurkowski (1989) sums it up nicely when he argues that the term information has been applied to so many things that it has become meaningless. He suggests that a new taxonomy of information should be developed, but he does not attempt to do so himself.

³ For a lucid and convincing defense of the concept of consumer surplus, see Hicks' essay, *The rehabilitation of consumers' surplus*, reprinted from its original 1941 publication in Arrow (1969). To illustrate his points, Hicks reproduces a diagram from Marshall which shows clearly the derivation of CS. Hicks wrote a series of essays in *The Review of Economic Studies* in the 1940s, some of which appeared in edited form in his *Wealth and Welfare* (1981). He makes the point (page 132): "Consumer's surplus is relative, not absolute" but argues that its ambiguities "are after all not so very formidable," and that therefore "Consumer's surplus remains a usable instrument of analysis."

⁴ A grasp of consumer surplus is vital to understanding the economist's view of what constitutes benefit to a society and how it can be represented and measured. In the following illustration, downward sloping line D represents market demand, and upward sloping line S represents market supply. They intersect at point b, so horizontal line ab is established as the market price. Because D also represents what consumers are willing to pay for the good, based on their perceived utility, the triangle CS above line ab is a measure of the total utility realized by consumers in excess of what they actually pay. This is called consumer surplus. Similarly, triangle PS below that line represents the difference between the

cost to producers of supplying the good and the amount received, which is called producer surplus.



CHAPTER 2

REVIEW OF LITERATURE AND CONCEPTS

Chapter 2 will examine theory, concepts and principles relevant to the study of cellular telephone duopoly. These cover a wide variety of material drawn from the literature of several disciplines. To present this material in a meaningful and logical framework, the chapter is divided into four broad areas: Communication concepts and theory, technical considerations, economic concepts and theory, and regulatory and policy issues. Each of these areas will have relevance in the later analysis of cellular.

Communication Concepts

Several concepts and scholarly approaches in communications are relevant for this study. Especially useful are some characteristics of communications which are closely related to concepts in the sphere of economics.

Demassification of the Media

A process of personalization or demassification of the media has been taking place in technologically advanced countries.¹ Use of traditional mass media has leveled off or is in decline, and consumers are turning more to individualized, point-to-point technologies. Telephone traffic continues to grow, and more sophisticated channels like computer networks are exploding. Often these point-to-point or limited access media are interconnected.

Various researchers and observers have perceived and discussed these phenomena. Merrill and Lowenstein (1971) termed the trend the EPS curve for the

progression of media from elite to popular to specialized. Aumante (1989) discussed the demassification of the media, which is a variation on the same theme. Maisel (1973) documented the trend toward specialization in American media during the period 1950-1970.

The result is a technology-based communication system which more and more resembles traditional face-to-face communication.² The system is becoming decentralized and users may now communicate directly with each other in all directions, not just through a mass medium. The new media are characterized by an abundance of channels, a variety of content options, and the virtual elimination of transmission barriers.³

Uses of the Telephone

The limited available scholarship on how people actually use the telephone, which in America is the primary channel of interpersonal mediated communication, indicates that acquisition of information in the traditional sense is not the sole reason for telephone use. Indeed, information acquisition may lag behind social purposes for many telephone users.

Keller (1977) describes two widely differing types of uses for the telephone, which she calls instrumental and intrinsic. Instrumental uses include such practical purposes as reporting emergencies, ordering goods and making appointments. Intrinsic uses involve facilitation of social contacts. She suggests that the telephone helps to create communities and strengthen communities created by other means.

In her study of a small Midwest town, Rakow (1992) documents that men and women typically use the phone for very different purposes. Women, who maintain social contacts for themselves and the family, use the phone for this purpose. They are comfortable with the intimacy of the device, as noted by Keller (1977) and Mayer

(1977). Men in Rakow's study were likely to use the phone less, keep their calls short, and only use the phone when it was needed for business purposes.

To apply Keller's terminology, women in Rakow's study used the phone primarily for intrinsic purposes, while men used it mainly for instrumental reasons. Women were also far heavier phone users, which is consistent with the findings of O'Keefe and Sulanowski (1992).⁴

Short, Williams, and Christie (1976) and Reid (1977) found that the way business people interact is substantially modified by the use of the telephone as the communication channel. Those who interact by face-to-face conversation tend to spend more time in social pleasantries and other extraneous communication. Those who are communicating by telephone tend to get right to business and accomplish it more quickly. Absence of the visual cues seemed to make conversation less protracted, but not necessarily less effective.⁵

All of the foregoing studies involved only phone use for voice conversations. Little scholarly research has been found which probes the purposes which underlie phone system use for the transmission of computer data, relay of broadcast signals, etc. Some research is being done on Internet use, but the telephone system is considered merely a component link or access means, and therefore is not the focus of such studies.

Uses and Gratifications Approach

An active subfield within mass communications research has been a branch of study termed uses and gratifications. Uses and gratifications researchers try to determine how and why consumers use the mass media. They focus their attention on media consumers as an active audience, rather than as inactive recipients of media signals (Palmgreen, Wenner, & Rosengren, 1985).

The uses and gratifications approach rests on five basic assumptions (Rubin & Bantz, 1989):

1. Users are motivated and purposive in communication behavior;
2. They take the initiative to choose communication media and messages to satisfy their needs and desires;
3. Social and psychological factors affect these choices;
4. Media compete with other forms of communication for the attention of users;
5. Users can articulate their reasons for making communication choices.

Hughes (1986) asserts that uses and gratifications could be used to ascertain market potential of new communications media, thus increasing the predictive power of the diffusion model. He suggests substituting personal need factors, as determined by uses and gratifications research, for the more traditional demographic characteristics usually employed as independent variables in diffusion studies.

There is a conceptual link between the uses and gratifications approach to assessing motivation and satisfaction, and the economic concepts of utility and preferences. Uses and gratifications, as a research paradigm or technique, may some day prove to be a useful tool in marketing research. It seems logical to probe consumer motivation factors to find indications of market demand. However the links between uses and gratifications and the estimated consumer demand curves used in economics are too tenuous to be useful. Much more research remains to be done in uses and gratifications and in marketing before reliable associations can be established, and objective quantification is possible.

Value of Information

Considerable attention has been given since work by Machlup (1980) on the economic value of information. Researchers, both empirical and theoretical, have wrestled with the intrinsic difficulty of assigning value to an intangible and elusive concept. Recent approaches have included the analysis of the value added by an

information input. This approach has logical appeal and is comparable to techniques applied in other areas of economics.

The problem, however, is that different individuals and organizations may place different values on the same body of information. Information that may be very valuable to one entity may be of little or no worth to another. Monk (1992) points out, in a somewhat narrower context, that the value of information is determined by what he calls the real use value of information in the economy. This in turn is a function of how information is used in production. To some producers, a piece of information may be very useful; to others it is of little use. Thus in Monk's view, information has no inherent value; its value arises solely from its usefulness in specific situations.

Neoclassical economics tells us that the same good or service is not equally desired (of equal value) to all potential users. Demand is a curve, not a point. Some people might pay \$100 for a bushel of wheat under certain circumstances. And there are those (who perhaps prefer rice?) who would pay no more than pennies for the wheat as long as their preferred foodstuff is available at reasonable cost.

Is information so different? Dervin and Nilan (1986) remind us of two conflicting paradigms for the evaluation of information. One school (they call it traditional) regards information as a collection of facts, with a specific value. The other school (they label it alternative) sees information from the perspective of the recipient (user). From this viewpoint, the value of information is highly subjective, dependent on the use to which the user can make of it, and therefore the user's perception of its utility. This is similar to Monk's position, but more broadly applied.

The insights of Dervin and Nilan create a logical link between the information "commodity" concept and the demand curve. Aggregate demand is nothing more than the sum of individual demands, and it is no different conceptually for information than for any other good. For any given bundle of information, some potential users may find great utility and thus be willing to pay a high price. For most users, however, the

value is likely to be much less, so we have many more potential users as the price slides down the demand curve.

What may confound empiricists is the tendency of information to face relatively inelastic individual demand curves. The midsize car might find many more buyers at only slightly lower prices (assuming that competition, complementarity and substitutability are unchanged). Not so with information. One information bundle that might be worth millions to some individuals or organizations might be virtually worthless to most of society. Another may be worth a modest amount, but be useful to many people.

Zurkowski (1989) distinguishes what he calls "hot" information, for which users will pay a lot, and "cool" information--relatively unimportant material that people buy only if it is cheap. Again, this is no more than a restatement of the concept of preferences, and aggregate preferences determine market value.

In the world of economics, therefore, information does not differ intrinsically from any other good. There are problems with it, of course: definition, measurement, relevant markets, etc. But these are problems for all microeconomics. A major difference is that economists, bureaucrats, businessmen and consumers long ago set the boundaries and definitions of many other products and services, so they do not have to be done anew each time we gather and examine data. The problems do not mean that information falls outside the bounds of traditional economic analysis. They just mean that some questions must be answered and boundaries drawn before meaningful study can commence.

More importantly, the Dervin distinction creates a promising bridge between the marketing approach--trying to determine the sources of need and satisfactions--and the economics approach--using data to construct demand curves. The key to both is the demand of the individual, which in turn is traceable to his needs and desires. Determine

these, add them up, and you have society's demand curve for any particular item or type of information.

Although information acquisition is important, we know from previously reviewed work that intrinsic or social use of the telephone is significant, and the satisfactions derived from it are even more difficult to measure. All preferences have value, however, and even if we cannot isolate the utility derived from this particular use, we can estimate from actual usage the value subscribers place on telephone service for all purposes.

Technical Considerations

Two attributes of communication systems appear to be especially relevant to this discussion. They are the applicability of the research paradigm to communication systems, and the pattern of innovation and diffusion of the communication technology.

Application to Communication Systems

The purpose of this paper is to analyze a growing communication technology--cellular telephone. This technology should be viewed as a component of an end-to-end system, not a mere device which can be interfaced in some manner with the public telephone system or other channel.

Planisek (1983) provides a typology for the study of computer systems: the machine (central processing unit) view; the system view; and the user view. Others have likened a computer system to a communications system. Planisek's perspective becomes useful as well in examining communications. We are concerned primarily with the user(s) of the system, but to understand the process we must also consider the machine and system views. Planisek's three-perspective approach also helps clarify the concept of an information system for our purposes.

Referring to the Planisek model: The communication channel or pathway is analogous to the machine view. In the case of cellular telephone, the communication channel consists of the radio channel, the cellular transmitter and switch system that interconnects it with the public switched telephone network (PSTN), and the PSTN "wireline" system. The transmission, on this pathway, consists of analog and digital electrical signals; that is, bits and bytes or the analog equivalent.

The system view is the entire physical system, including the telephone handset and transceiver at the mobile end, and the ordinary wired telephone (in most cases) with which it is communicating. Increasingly, the sending and receiving devices may be computers as well. The system is often transmitting voice signals, which semiotics would call signs and code. To do this, the system must transform the voice sound waves to electrical form at one end and reconvert the signals to voice simulation at the other, as telephones have been doing for more than a century. So at the system level, voice is being transmitted, not just bits or waves.

The traditional user, of course, transmits and receives not mere formless sound, but speech (or other audio signals). Voices usually speak words, and so the humans carrying on communication speak and hear words and intonations, with the various meanings they may carry. The human users are not particularly concerned with the translation which takes place to digital and/or analog signals, subsequent transmission, and translation back to speech. To the user, most of the technical aspects are transparent; they are unseen.

Seen from the user view, the purpose of cellular telephone technology is to transmit information. It is not of great consequence to us here whether the recipient of the information understands precisely the meaning the initiator was trying to transmit or not. Although we are interested in the users' perceived value of the entire system--including information transmitted--the value of the information itself is ancillary to the scope of this study.

We cannot entirely ignore the value of the information, however, because of the utilitarian nature of the technology. For example, cellular telephones have proven especially useful in the construction business, where communication with workers at construction sites carries high utility. So it is obvious that the communications system itself and the nature of the information interact to produce value. Other industries that do not require the mobile characteristic of cellular telephone may find the technology much less useful.

Nonetheless, our central concern will be the channel, its particular characteristics, and the economic ramifications of its use. In the foregoing discussion, we have made no mention of either the meaning or purpose of the transmission--the semiotic aspects of the communication process.⁶ This study will focus on the system, concentrating on the economic aspects of the technology, not the information. The economic aspects, in turn, are evidenced by data generated by user behavior. Examining the concept of information from this perspective, we find that Braman's characterization of information as a resource is most appropriate. Information as the perception of pattern or as a constitutive force in society are not appropriate views, because they require processing and interpretation which takes place outside the communication system.

Innovation and Diffusion of Technology

Cellular telephone in its first decade went very quickly through its innovation and early diffusion stages. These stages are characterized by shifting demand and supply curves, and consequent instability in prices. Economic information about the benefits of the service, imperfect at best in mature industries, is usually very difficult to acquire during the early stages of an industry.

In the industrial setting, von Hippel (1988) found that a subset of users are very likely to be the innovators for a particular technological advancement. He suggests that

need begets innovation, and that an innovation is most likely to result if a particular user sees an opportunity to extract economic rents (greater than normal profits or benefits) from an innovation. The user who has the best chance of extracting rents, or who most clearly perceives the opportunity, is the probable innovator. This is classic entrepreneurial behavior.

Antonelli (1989) calls information technology "clear evidence" of von Hippel's thesis that users themselves are likely to be innovators. The term "innovator" as used by von Hippel is somewhat different from the term as used by Rogers (1983) in diffusion theory. An innovator to von Hippel refers to the originator of a product or process that provides a competitive advantage. Rogers uses the term to mean a pioneering adopter. The difference is more in degree than kind, however. The pioneer may be either inventor or adopter--possibly both. The first adopter could be the inventor. Thus, in reference to the economic environment, both the inventor/adopter and the pioneer/adopter are in similar circumstances: They both stand to benefit from large surpluses--economic and/or psychological--associated with very early adoption.⁷

Sirbu (1981) notes that the increasing value of many communication technologies as user base increases has the effect of accelerating diffusion. Vendors, recognizing this, are likely to price products to minimize costs for early customers, and build user base quickly.

Rogers reviews a large body of primarily anecdotal evidence on information sources and flows which lead to adoption. In many cases, awareness may be created by the media or an outside influence, such as a government agency. However, interest often will not develop until that source is validated by further information from a more trusted, local source, like a neighbor or family member. This is consistent with the two-step flow theory of community news dissemination first documented by Lazarsfeld, Berelson, and Gaudet (1968).

In dealing with any new technology or procedure, the pattern of its diffusion is an important aspect. Economics involving new products or new technology is especially concerned with diffusion patterns, because the diffusion pattern itself may have an influence on eventual acceptance and competition with other innovations. Of particular interest in communications technologies are external factors which may distort the normal diffusion pattern, such as monopolistic behavior, regulatory interference, or the effect of increased user-value.

The normal pattern of diffusion of innovation is the classic bell-shaped curve (Rogers, 1983). Rogers has divided the diffusion process into five segments: innovators, early adopters, early majority, late majority and laggards. From the data on the introduction of numerous innovations, he concludes that diffusion normally starts slowly, gradually gains momentum, and that this momentum wanes after half of the potential user population has completed adoption.⁸

Rogers divides the process of adoption by the individual user into five stages: awareness, interest, evaluation, trial, and adoption. Although a few adopters skip one or more stages, he reports that most adopters go through all five. The length of the adoption process for a particular innovation can vary considerably for different users.⁹

Communications technologies have some unusual characteristics which may cause patterns of adoption to be quite different from other innovations, however.

Conventional economic criteria of price and demand elasticity may be inadequate for analyzing the diffusion patterns of a communications technology (Antonelli, 1989). Antonelli suggests that issues of externality, public goods, and interdependent preferences are significant enough to deserve consideration.

He argues that two significant factors characterize diffusion of information technology:

1. The unequal distribution among potential users of the ability to appreciate the economic importance of a technology;

2. The technical quality of the telecommunications infrastructure.

Antonelli finds that demand and the perception of it for telecommunications services is strongly influenced by three special circumstances:

1. The highly dynamic demand is increasingly associated with sales and usage of information technology products with strong complementarities and low price elasticities;

2. The quality of the telecommunications infrastructure, in terms of capacity, reliability, speed, and compatibility for data communications, is very important;

3. Current estimates of price elasticities are biased or misleading, because they are obtained from static models that fail to recognize the effect of low penetration levels. Much of the new demand will come from users and firms not represented in the elasticity data.

It can be deduced, then, that the normal curve representing the diffusion of a new communications technology might be distorted in various ways, for instance:

1. Introduction may be delayed or slowed down, later resulting in shorter innovator and early adopter periods. This may help explain the unusually steep introductory curve of television.

2. Regulatory constraints may prevent the market from developing normally or fully, resulting in a much lower curve than might be expected in a *laissez-faire* situation. Conversely, constraints on competing technologies, or inducements for a particular technology, might bias the market toward a technology, thus enhancing the curve. FCC policy differences in setting stereo broadcasting technical standards for FM and AM radio may have had a lot to do with the success of one and not the other. The FCC set the standards for FM stereo, leading to national acceptance. The FCC declined to set the standards for AM stereo, opting to allow the market to set the standards. The AM market has failed to achieve consensus and ultimate acceptance. It can also be argued that timing was a factor in this particular situation. FM stereo was well

entrenched by the time AM stereo received serious consideration, so the window of opportunity may well have passed before the issue arose.¹⁰

3. The uneven nature of technological development may slow down or speed up diffusion. For example, when analog facsimile was introduced, it never achieved wide use (Costigan, 1978); when facsimile returned in digital form in the '80s, speed and quality were improved and cost reduced, resulting in widespread acceptance.

Antonelli concludes that three underlying factors are most influential in the diffusion of telecommunications services:

1. External aspects of the capital markets, such as interest rates, market trend expectations, age of existing capital goods, and availability of financial resources;
2. Shifting supply curves and reductions in market price due to decreasing production costs and increased competition;
3. The process of collective learning, which reduces adoption costs, and the continuing increase in user value as networks increase in size. These are manifested in shifting demand curves.¹¹

Antonelli's analysis suggests some interesting implications for cellular telephone during its early growth period: Investors and speculators alike saw profit possibilities in the mere ownership of a local area license. At one point, licenses were being awarded by lottery, and speculators who had little intention of operating a cellular system sought and won the right to do so. Large national firms bought up franchises. The capital markets clearly saw potential. Supply was not a problem, because cellular phone operating firms eagerly made the necessary investments to begin operations, providing ample initial supply in major markets. Arguably, the controlling factor in cellular growth, then, was Antonelli's third factor, the collective education of the public regarding the value of the new technology. Because cellular is an extension of the wireline network and not a self-contained network, growth of the cellular network itself probably had limited influence.

Economic Theory and Concepts

A number of economic concepts must be examined to understand their application to this study, and realize the peculiarities of the communication channel in economic terms.

Consumer Theory

Consumer decisions, from the economics perspective, are based on a hierarchy of interrelated preferences. Each consumer faces an array of possible bundles or combinations of goods and services which he can afford. The consumer selects the combination which is expected to yield the most benefit or utility.

Each consumer's buying decisions are based on his preferences. Thus the consumer's preferences are revealed in his purchases. The decisions and the consequent acts of purchase constitute the most accurate reflection of consumers' preferences. Purchase transactions data reveal these preferences.

To make purchase decisions, each consumer must determine or estimate the utility to be derived from each purchase. In many cases, this is based on experience, as well as current knowledge. However, until the purchase is made and the product or service put to use, the consumer cannot know just how much utility will be realized. The problem is further compounded in the case of new products or services, or products and services which may not even be available at the time the preference is expressed.

Creation of Demand

Neoclassical economic theory assumes that for most goods, the number of units purchased increases as the price goes down, creating the familiar downward-sloping demand curve. From another perspective, the amount of benefit that a person receives per unit of currency spent (marginal utility) decreases, as the buyer or the market

acquires more of the good. So price reductions are required to induce more consumption of the particular item, either to increase sales to current consumers or attract new ones.

The aggregate demand curve (customarily referred to as the demand curve or D) is conceptualized as the horizontal sum of the demand curves of all individual potential buyers of a product or service. The aggregate demand shows the same downward slope, but the slope will tend to become less and less steep as more demanders are added to the pool.

Using the reasoning of Rogers (1983), Allen (1988), and Antonelli (1989), diffusion of technology may be driven by shifts in individual, and therefore aggregate, demand curves, facilitated by the transmission of information from early adopters to later adopters. In such a dynamic situation, supply factors may play a comparatively minor role.

Demand for information technology, including communication services, is derived from customer demand for information, according to Monk (1992). Information itself is processed and communicated because it has a use value in production. Therefore, the demand for information technology products is dependent on the real use value of information in the production economy. If that can be established, the value of communication services can be derived.

Monk raises some questions, however, as to how demand for new information technologies is created and ascertained:

1. How can customers "demand" new systems or services of which they are unaware? In many cases, he points out, new systems meet needs which were apparently nonexistent or at least unknown before the technology was introduced. By its nature, he argues, innovation is a new way of doing something, not merely an improvement on the old method.

2. How can engineers assess customers' needs when they lack information about the customers' domains of activity? In particular, since the customers themselves are unaware of activities or needs prior to an innovation, how can engineers anticipate them?¹²

Standard consumer behavior literature identifies three theories to account for consumer decisions (Runyon, 1977):

Utility theory. Derived from economics, this supposes that consumers are rational beings trying to maximize their utility (benefit) through their purchase selections.

Risk-reduction theory. The vast array of possible purchases presents high risk to consumers contemplating purchase. Therefore, they rely on strategies to eliminate some choices and reduce risk.

Problem-solving theory. The classic consumer problem is the perceived difference between the existing state of affairs and a desired state of affairs. The consumer's task is attempt to satisfy needs, wants, goals and desires and close the gap between existing and desired states.

The problem-solving model is the standard approach in marketing textbooks. In its simplest form, it specifies a five-step process of consumer decision-making: Problem recognition, information search, evaluation and satisfaction, store choice and purchase, and postpurchase processes.¹³

The problem-solving view of consumer behavior does not have to be at odds with utility maximization, at least if income difference concerns are ignored. The desirable state of affairs can be defined as the pareto-efficient state, in which no reallocation of resources can improve total utility. The utility concept can even subsume risk-reduction, because risk-aversion may be a factor in preferences.

Both economists and management scholars have accepted the concept of satisficing (Simon, 1976) to help explain some decision-making behavior. The

satisficing consumer does not investigate all possible alternatives before making a purchase decision. Instead, the satisficing consumer may adopt any one of a number of alternatives which meet minimum acceptable criteria, very likely the first such alternative encountered. Some critics have suggested that satisficing behavior violates the assumption that consumers make rational decisions, and thus calls into question the whole notion that consumers maximize utility. This is not necessarily true.

Conducting a search for purchase information in itself entails a cost. A satisficing decision could well include a decision that continuing a search would be more costly than accepting the currently available solution. If the cost of the search is included in the cost of purchase, satisficing can be also considered a tactic for maximizing utility.

To summarize: Demand derives from consumer perception of expected utility. In the case of new products and technologies, the development of demand is closely tied to the dissemination of information and the resulting expectations of utility. Thus, demand for innovations is characterized by shifting demand curves and low predictability.

Interpersonal Comparability of Utility

Economics, by a common definition, is the study of the allocation of resources. Efficient allocation--often cited as the ideal in economics--is allocation done in such a way that levels of utility are maximized for each consumer, within his budget constraint. The utility gained by the last purchase, known as the marginal utility, should be the same across all goods for each consumer. If that is not the case, the consumer who has a higher unfulfilled need will bid more, causing a reallocation of goods within his budget constraint and a reallocation within the market. The market mechanism is presumed to be able to accomplish this efficient allocation. If the market is unable to do so, the result is market failure.

This raises a problem that current economic theory has been unable to deal with, however. Consumer behavior theory provides for the rank ordering of utility-providing bundles, but not the assignment of absolute values to those bundles. The consumer, faced with choices between alternative bundles of goods and services, can differentiate between the bundles in terms of utility, and thus can evaluate them. However, the researcher observing demand cannot assign cardinal values to the bundles, and thus has a limited ability to compare them in terms of relative or absolute amount of utility offered to different consumers.

This seems counter-intuitive. Every consumer must compare prices (value in terms of financial resources) and decide which goods and services to purchase. Such choices involve decisions concerning relative values. In a world of limited resources, is lettuce at 59 cents a head a better buy than tomatoes at \$1.99 a pound? For some, the answer is yes, for others no. Others may not have to make such a choice; they can purchase both. There is no ultimate answer to the question, yet each consumer has a personal answer. Utility--at least expected utility or preference--is expressed through purchasing (allocative) decisions.

The problem is not that the consumer is unable to assign relative values of utility and apply cardinal values. Every time a purchase decision is made, such a value judgment is being revealed and recorded. The problem is the limitation of economics or other social science in determining--on an objective basis--the consumer's subjective scale of relative values before the purchase is made.

Solving that problem is only the first step in the larger problem of consumer behavior, though. A scale of relative utility values is personal and subjective. Expressing those utility values in terms that can be used to compare and compile sums of consumer values is a far more daunting task. How do we know that individual A's utility scale is comparable to individual B's?

Klappholz (1984, p. 282), quotes Robbins' comments that interpersonal comparisons of utilities are not testable by observation, introspection or by asking questions. Robbins contended that interpersonal comparisons of utility are value judgments and had no place in scientific welfare economics. Arrow (1964) takes a similar position, stating that interpersonal comparison of utilities has no meaning (p. 9).

Economics addresses the conundrum by bypassing it. Rather than attempting to perform the impossible and measure individual or total consumer utility, economics goes to the next step--purchase decisions. Purchases are observable and measurable, and are the logical result of preferences translated into action. By making a purchase, the consumer has not only expressed his desire, he has made the decision to forego some other purchase or allocation. Thus, his total consumption is an expression of preferences.

Once individual purchase allocations are made, they can be added up to determine the aggregate consumption preferences of a society. Several problems are neatly solved: Individual consumers reveal preferences by making their choices, there is interpersonal comparability on the basis of purchase decisions, and credible data are generated on the total needs or consumption of the society.

Elasticity and Demand Curve Shifts

Elasticity is the characteristic of a demand curve indicating the relationship between price and unit sales. If a percentage decrease in price is more than matched by a corresponding percentage increase in sales, resulting in an increase in total revenue, it is said that the demand is elastic. If, however, price has relatively little effect on sales, the demand is considered to be inelastic. An inelastic demand may be advantageous for sellers, because they can raise prices without losing much in sales.

During a period of diffusion, the demand curve is likely to be shifting to the right, consistent with previously discussed trends. Until a period of relative stability or

equilibrium has been reached, it will be difficult to estimate the demand curve for a good. This observation alone gives no indication of elasticity per se if the curve is shifting, because we are unable to isolate buyer behavior in response to price changes. A demand curve may be either elastic or inelastic as it shifts outward, and the elasticity is likely to change. However, if the initial demand curve had a very steep slope--being very inelastic--an assumption that the curve would retain its steep slope seems counterintuitive. To accept such an assumption would imply that the intercept of the curve on the price (vertical) scale would become astronomically high, given the high growth rate of subscribers.

Duopolistic Competition

Duopoly is a market structure characterized by only two supplier firms in direct competition with one another. Although often presented and examined as a simplified model by which to study oligopoly, duopoly is the dominant market structure in the U.S. cellular telephone industry, by order of the Federal Communications Commission. Thus, duopoly is not just a domain for economists examining a theoretical world. It actually exists in a pure state in the real world--in hundreds of cellular markets.

Since cellular telephone markets are duopolies by decision of the FCC, the main question becomes whether rates paid by consumers and consumer surplus are adversely affected by this policy. It is also of some concern how the duopoly environment affects vendor behavior.

Friedman (1983) uses duopoly examples frequently in his comprehensive work on oligopoly, but rarely treats it as a distinct case. He does examine the leadership models which may characterize duopoly, including the Cournot, Bertrand and Stackelberg models.

The Cournot model rests on the premise that participants in a duopoly or oligopoly regard output as their primary decision, and that they make this decision

simultaneously, without accurate knowledge of the intentions of their competitors.

They must, however, attempt to predict what their competitors are likely to do.

Although Cournot is a single time period model, it can be assumed that if the period is repeated, firms will be influenced by their competitors' behavior in previous periods.

Cournot showed that under his model, firms in a duopoly would produce more than a firm under monopoly but less than those under perfect competition. In the same situation, price would be less than monopoly price and more than the pure competition price (Blaug, 1985).

The Bertrand model assumes that price, not output, is the variable to be manipulated by the producer firms. In this model, the oligopoly participants will attempt to achieve a desired price level, and adjust output to assure that price. Like Cournot, the firms make their decisions simultaneously, without full knowledge of each others' decisions.

The Stackelberg model changes the sequence of decision-making, and places it in a context of market power. Under Stackelberg, the firm which is the market leader sets output, and other firms make their output decisions knowing (or receiving signals, at least) about the leading firm's output policy.

Friedman notes that the nature of the industry determines which model is the best approximation of the actual situation. Some types of businesses find it relatively easy to adjust prices, but may be limited by high fixed capacity or high costs of adjusting output. Other industries may find it comparatively easy to adjust output, and have relatively less price flexibility. In the case of the Stackelberg model, industry structure and culture may indicate a dominant firm which is likely to behave like the leader. Different firms in an industry may take the role of leader at different times.

Anderson and Eggers (1992) determine that oligopoly profits are always higher under a Cournot situation than a Stackelberg one. They reason that, faced with a Stackelberg setting, each firm, when it takes its turn to determine output, will set output

higher than it would have under Cournot conditions, to discourage the next firm in turn from producing so much. Therefore, the entire industry is likely to overproduce and drive prices down, reducing profits. Product differentiation or other non-price competition may blunt the impact of price competition, to the point that a firm may successfully ignore its competitors' behavior in setting price or output (Geroski, Philips, & Ulph, 1985).

Even if price competition in a duopoly is not anticipated, consumer surplus should be greater than what it would have been under a monopoly (Ng, 1991). This is because duopolistic firms will still compete on the basis of service, which will give the consumer better value and increase demand. Although Ng's reasoning appears sound, others might interpret such a case as redefining or differentiating the product and thus shifting the demand curve.

Hazlett (1990), in his analysis of duopolistic competition in cable TV markets, finds that consumer surplus increases following a shift from monopoly pricing to competitive pricing under duopoly, for two reasons:

1. Prices are automatically forced down, because that is the new entrant's means of attracting customers away from the incumbent monopolist. So an amount equivalent to the difference between the monopoly price and the duopoly price, multiplied by the number of subscribers served by the incumbent, is shifted to consumer surplus from producer surplus.
2. In addition, consumer surplus is increased to the extent that new customers are attracted to the market in addition to those served by the formerly monopolistic incumbent. This surplus forms a triangle under the demand curve to the right of the original quantity served.

Total welfare may be decreased if the average costs of the incumbent firm are increased, resulting in a decrease in producer surplus. Producer cost functions and economies of scale would affect the outcome.

Hazlett sees three distinct benefits to consumers in a situation where the new entrant endures in cable TV: Permanent price reduction, expansion of output, and product differentiation. If entry is attempted but does not endure, he also sees three consumer benefits: Short-run price competition, output expansion, and the better adaptation of the surviving firm to consumer tastes. The third benefit--adaptation--probably applies to both sets of circumstances.

Hazlett demonstrates that in cable television, multiple entry including duopoly, or the threat of it, is positively associated with an increase in consumer surplus, even if a natural monopoly exists. In a natural monopoly (subadditivity) condition, a monopoly operator will be forced to set rates no higher than the level of sustainability to protect the monopoly, if unrestricted entry is permitted by law or regulatory agency. This is consistent with the performance of a contestable market (Bailey & Baumol, 1984).¹⁴

The airline industry has many city pair routes that are duopolies, but it is difficult to isolate data for effects which can be traced to the duopoly structure. The low-traffic routes tend to cluster around major hub airports, and ticket prices are inextricably tied in with connecting flights and longer journeys. Unbundled prices could be separated out, but they would not tell the whole story. Analysts differ in their conclusions on the competitive effects of deregulation of the airline industry. Morrison and Winston (1995) estimate that airline fares were 22 percent lower in 1993 than they would have been if airline regulation had been continued. They do not provide comparable numbers for lightly served or duopoly routes, but they do note that real fares have increased for distances of less than 800 miles and decreased for longer distances. They imply that this can be attributed, at least in part, to elimination of the earlier practice of subsidizing short flights from the profits of long ones. They also report that deregulation has caused the proliferation of fare categories. Shepherd (1990), in a harsher critique of the airline industry, argues that the quality of service has

deteriorated along with the reported lower fares, and suggests that recent mergers may have reversed the trend toward lower fares.

Danner (1991), a California regulatory agency official, expresses frustration at trying to determine whether a cellular telephone duopoly is competitive or not. Oligopolists, he asserts, will customarily charge the same price. If they compete, duopolists will set their prices the same. If they collude, duopolists will also set their prices the same, but higher than if they competed. From observation of price behavior, regulators cannot tell whether competition or collusion is taking place, because either may result in uniform prices.

To make analysis more difficult, the cellular license represents a scarce resource, and therefore a source of possible extraordinary profits which economists call "rents". So even if regulators determined that prices were higher than marginal costs, it would be difficult to interpret whether that would be evidence of collusive behavior or merely a justifiable return on the value of the license.

Pricing Strategies

One of the main tools of business is pricing strategy. It can serve both as a competitive strategy and a strategy to maximize profits. Although economists, in presenting and discussing economic principles, often set the assumption of level pricing for all customers, in reality that is often not the case. In many industries, including utility industries, various kinds of price differentiation are practiced. Price discriminating firms charge different prices for different classes of customers, or for different conditions of purchase. Some common forms of nonlevel pricing practice include:

Nonlinear pricing: Charging varying prices, even to the same customer, based on quantity purchased. This customarily means that larger purchases entitle the customer to lower unit prices.

Multipart pricing: Consisting of two or more discrete fees, each of which can be varied independently. Its usual form in utility pricing is an access fee and a variable fee depending on usage, which is a common pattern in telephony.

Discriminatory pricing: Charging different prices to different customers or classes of customers based on the elasticity of individual or group demand curves. Customers whose demand curves are less elastic will be charged higher prices, because they will reduce their purchases less as prices are increased.

Intertemporal pricing: Pricing based on the timing of the purchase. Purchases made in a period of increased demand or restricted supply will be charged at higher rates. A variation of intertemporal pricing is peak load pricing. A common concept in utility industries, peak load pricing means that the highest prices will be charged when the demand is greatest. Total capacity is determined by peak load. Therefore, peak load customers are assessed more of the business burden. Conversely, customers who purchase in non-peak periods are charged less, possibly down to the level of the marginal cost of production.

Introductory pricing: A lower-than-normal level of pricing to attract initial customers. This is a common tactic when introducing a new retail product, but it makes considerable economic sense in communication industries where network externalities are significant. This could be seen as another variation of intertemporal pricing, because the producer plans to raise the price once a clientele is established. It also might be used to attract early adopters with the promise that they will have the benefit of lower prices than later purchasers, encouraging diffusion and building a customer base.

Entry pricing strategy is a problem for vendors, especially in a totally new market like cellular telephone. If vendors perceive that costs will drop quickly, or that marginal costs will be low, leading to significant economies of scale, such perceptions may have a great influence on entry prices. Adams (1990) uses a body of theory called

rivalry to examine entry behavior, including pricing, in cellular telephone markets. He finds that, although cellular firms changed pricing strategies frequently in competitive situations, it was not possible to determine with any certainty whether the changing tactics were in response to business rivalry or other factors in new and growing markets.

Price discrimination is an attractive tactic for monopolistic or oligopolistic firms which have a homogeneous product or service, and which face demanders with widely varying elasticities of demand (Kahn, 1970). Essentially, the firm is attempting to charge what the traffic will bear; i. e., more than marginal cost of production but less than the demand curve of the individual customer. If marginal cost is decreasing, it may actually prove to be efficient, because it will enable more customers to buy the product than any flat pricing scheme would permit. No customer pays more than he is willing, so nearly every customer enjoys some consumer surplus. From a public policy point of view, it may also serve to address equity concerns.

The industry which has arguably been the most successful in practicing price discrimination is the U.S. airlines industry. This industry makes no apologies for the fact that it has an incredibly complex pricing structure, and one which is changing constantly. Shepherd (1990) reports that the major airlines have large staffs whose sole job is to monitor passenger loads, and juggle prices both to fill passenger seats and to extract the highest possible fare from each passenger.¹⁵ Shepherd, as well as Morrison and Winston (1995), cite figures that show a decreasing real cost of airline fares since deregulation in the late 1970s. Shepherd also cites increasing load factors, which are an indication of the industry's success in building new business. The price discrimination is driven by the fact that, like telecommunications, the airlines have high capital and fixed operating costs, and very low marginal costs as long as there are empty seats on a scheduled flight. Airline passengers, in turn, exhibit wide variations in their individual demand elasticities. The airlines have developed complex rules that are

designed to distinguish between low elasticity and high elasticity market segments, allowing the carriers to benefit from the price discrimination practices.

Market segmentation is a time-tested marketing tactic that may be seen as another manifestation of price discrimination. A marketer may attempt to segment the market merely as a sales tactic, or he may be trying to identify and isolate a customer group that he is best suited to serve as a market niche. Price discrimination is only one of a number of techniques which the marketer might use in this effort.

Differing costs of providing service may give incentive to management to charge different prices for similar services. Thus, the customer of a rural telephone system may be charged a higher price than his urban counterpart to be on a network with a similar number of other customers in the local exchange.¹⁶

Two-part pricing is simple in concept: The customer pays an access fee, normally fixed, for the privilege of using the service, and a second variable fee according to the amount of usage. The implementation of such a system adds a small cost for metering usage, but otherwise, it is a simple system to administer. A common model is to set the access fee to cover the fixed costs of the system. This can insure that the supplier firm would be viable, even if output were zero. If this can be done, the firm may adopt a regime of marginal cost pricing to cover variable costs.

In the case of telecommunications, with its relatively high investment and relatively low variable costs, the high access fee may serve to deny service to low-income consumers. Likewise, once given access, low-income consumers may find that they have little problem paying the low usage fees.

Berg and Tschirhart (1988), considering the case of a natural monopoly, discuss increasing the access fees for demanders who stand to reap substantial consumer surplus from the use of the service, thereby making it possible to reduce access fees for consumers further down the demand curve.

As long as the access fee is less than the surplus, the consumer will continue to subscribe to the service, assuming there are no other choices. The vendor is practicing price discrimination, although the motive is cross-subsidization, not excessive profits. The tactic will work as long as the consumer paying the higher access fee can be made to do so. Resale of the service must be impossible, or else those paying lower access fees will find it profitable to resell.

Such a discriminatory pricing system may be voluntary if there are incentives for customers to pay the higher access fees. This inducement may be in the form of lower variable usage fees. But this implies that marginal cost is not the basis of pricing, and that the smaller customer is paying a price significantly higher than marginal cost (MC). This will tend to have the opposite of the desired effect. The customer with less ability to pay, or who is further down the demand curve by choice, will be excluded from a voluntary market.

Competition will have an adverse effect on a system of charging discriminatory prices to customers with higher surplus. There will be strong incentive for one firm to reduce its access fees in order to cream-skim the market by undercutting its competitor. This will have the effect of reducing all excessive access fees and eliminating the source of the cross-subsidy. The firm, in turn, must again distribute its costs more equitably across its customer base, including the customers least able to pay. This will increase prices at the low end and restrict the market.¹⁷

Network Externalities

Any consideration of economics involving communications and communications networks must include the effects of externalities. Externalities are defined by Whitcomb (1972, p. 6) as "when some activity of party A imposes a cost or benefit on party B for which A is not charged or compensated by the price system of a market economy." White restates it as "an effect on others besides the direct parties in

an activity" (1982, p. 23). In other words, an externality occurs when the uninvolved party B either gets something for nothing, or is subject to a loss for which he is not compensated.¹⁸

The literature of telecommunications externalities focuses mainly on the benefits that are conferred by the existence, expansion, or access to a communications network and that accrue to parties who are not charged for these benefits. The classic example is the increased utility of a telephone network when additional subscribers are added.

Rohlf's (1974) examines the matter of the telephone network externality, which he calls interdependent demand, and develops models to determine the maximum equilibrium user set and the critical mass (the point at which growth is self-sustaining). He posits that for individual users, utility is typically primarily dependent on access to a few principal contacts. Adequate utility may be created for a particular user by providing access to as few as two or three mutual contacts. This is consistent with Rakow's findings, based on user patterns in a small community.

Willig (1979) refines the concept of network externalities to make them measurable, using the increase in consumer surplus which occurs as a network adds new customers. He notes a curious paradox which may be evident in the problem of the pricing of network services. Under usual conditions the efficient price for an additional customer is the marginal cost of production. In the presence of network externalities, however, benefits accrue to existing subscribers as well as the new one. Hence, service conceivably could be offered to an additional subscriber at less than the marginal cost, which would result in additional consumer surplus to all subscribers to equal or exceed the marginal cost.

Willig also notes some other possible effects of network externalities:

1. Going beyond the customary case of the self-contained network to consider the case of interconnecting two otherwise distinct networks, he finds that the total surplus created by both networks will be increased because of the greater number of

accessible subscribers. Katz and Shapiro (1985) present proof of this phenomenon, and extend it to show that output will therefore be increased. They also discuss the conditions under which it may or may not be advantageous for the network firms to create interconnectibility. This increase in total surplus is also supported by Fullerton (1989a) using different methodology.

2. Discriminatory pricing strategies which attract customers who might otherwise not subscribe may increase total consumer surplus because of the extra value created by the addition of more subscribers.¹⁹

The effect of network externalities can be represented as a change in the demand schedule as the number of subscribers changes, as Bracutigam (1979) points out in his comments on Willig's article. Fullerton (1989b) comments, however, that such a case could be regarded as a new demand schedule, because the product has been redefined with the additional of new subscribers.²⁰

Considering a two-part tariff as the presumed rate model, Curien and Gensollen (1990) examine the two segments of consumer utility--access and usage. The value of access lies in network externality--the ability to contact other customers. This should form the economic basis for access fees. The value of usage derives from the utility of individual calls, which should form the basis for variable usage charges. Each tariff segment will have its own demand curve.

Entry Barriers

The ease of entry into, and exit from, an industry may have a substantial impact on competitive conditions in that industry. Such factors as investment required, technical expertise, and market power of incumbents are often influential. Two factors are of special relevance to telecommunications: Regulation and technical standards.

Regulation: Telecommunications businesses have traditionally been highly regulated, unless they are operated by an arm of government. In the U.S., the Federal

Communications Commission is the federal regulatory agency for most aspects of telecommunications, and states have public utility commissions or other agencies that have some authority over telephone and related technologies. FCC has especially far-reaching authority, because it alone can assign frequencies and issue licenses to users of the electromagnetic spectrum. In 1993, Congress effectively limited state regulation of mobile radio services, including cellular telephone, severely restricting the power of states to regulate price or market entry and reserving these rights to the FCC (Communications Act of 1934, as amended, 1993).

Technical standards: Technical standards can be an effective barrier to entry under certain conditions. Standards may, in certain technologies, be protected by patents, copyrights or proprietary ownership of information, thereby placing control in the hands of the owners of those patents, copyrights or information. In other situations, technical standards may be set cooperatively or by an industry or government agency, but serve to limit the ability of new firms to compete. Sheer market power may give a company the economic clout to set standards, as in the case of IBM unilaterally setting the operating system standard for the personal computing industry.

One other factor may constitute a significant barrier to entry in many markets-- financial strength.

Financial considerations: Small firms contemplating market entry against well-financed competitors may find that, although the opportunity is tempting, the risk of failure due to limited resources is too great. There are many strategies which well-established firms may legally use to meet threats of entry, and the firm with the deepest pockets stands the best chance of winning. Midway Airlines, seizing an opportunity, used a new marketing and pricing strategy to gain a foothold. When competitors matched its prices, it was unable to sustain the effort and eventually folded. Conversely, a well-financed newcomer may muscle his way into a market against a poorly financed incumbent. IBM entered the personal computer market late, but soon

won dominance with its well-established marketing organization and willingness to invest large sums.

Setting Standards

Standards have been the object of considerable study by economists in recent years, a trend related to the increasing importance of telecommunications and computer-based technologies. Economists are particularly concerned with two motives behind telecommunications standards: compatibility and variety reduction. The motive depends in large part on the role of the player.

Compatibility, which has received the most attention from economists, is a concern primarily of the users of a system or network. Communication network users want to be able to communicate with other users, and economists have stressed the resulting network externalities, which make a network more valuable if it has more subscribers. Variety reduction is a concern primarily of producers, which may reap economies of scale or market power if product variety is reduced (Sirbu & Zwimpfer, 1985).

Standard-setting processes fall into three classifications: Government mandate, voluntary cooperation, and the market mechanism with no cooperation (Besen & Saloner, 1988). Besen and Saloner note that cooperative standard setting is a widespread practice in the U.S. private sector, giving rise to a complex web of committees and industry bodies which formulate and set standards. Berg (1989) comments that firms are motivated to cooperate on setting standards because a standards rivalry process may involve years of deferred revenue due to smaller market demand. Berg adds that cooperative processes also may serve to reduce variety, with the related benefit of cost savings for vendors.²¹

In cellular telephone, local market structure and most technical standards are set by the Federal Communications Commission. The FCC declined to set the standards

for transmission of digitized cellular signals, however. As a result, the market has not yet reached a consensus on this issue.

Standards are not necessarily pushed toward optimality by free market conditions. They are very likely to become strategic tools in the game of competition, subject to use by market participants which for various reasons may already have a preponderance of power. It remains to be seen whether any cellular firms can capitalize on standards differences to gain market advantage.²²

Regulation and Policy Issues

Regulation is one of the most important tools which government can utilize to influence private entities in order to meet public policy objectives. A review of regulatory theory and significant policy objectives in telephony follows.

Theories of Regulation

The conventional view of government regulation of private business is that regulation is carried out in the public interest to protect the consumer from excesses of business (Stigler, 1971; Horwitz, 1989).

The theory, as applied to utilities, says that because most utilities are monopolies in their service areas, regulatory agencies must oversee them to assure that rates are reasonable and standards of service adequate. Other types of businesses and professions may also be regulated for various purposes, such as to set and enforce health and safety standards, assure adequate levels of competence, or prevent falsehood in advertising.

Stigler (1971) breaks with this view and theorizes that industries will welcome regulation to protect themselves from competition. He cites the Civil Aeronautics Board, the Federal Deposit Insurance Corp., the Federal Power Commission and state

occupational licensing agencies as examples of regulatory agencies which protect their industries.

The Federal Communications Commission, with its power to assign spectrum by use and license individual users, seems to fit Stigler's model of an agency which has great power to restrict entry and thus benefit existing firms.

Peltzman (1976) takes Stigler substantially further, refining and extending Stigler's ideas and formalizing them mathematically. Peltzman draws several conclusions:

1. The probability of industry creation and capture of regulatory agencies is a function of the power and unity of the industry, and size and diffusion of the impact among consumers;
2. Industries will seek regulation if the benefits exceed what they can gain in the unregulated marketplace;
3. Industries will undertake to create or capture regulatory agencies if the expected benefits of regulation exceed the cost of capture;
4. Despite the monopoly power conferred by regulation, regulated industries will cross-subsidize, thus offering service below cost to selected market segments.

Horwitz (1989) cites a group of theories which he labels "perverted" public interest theories, because they aver that the public interest has been thwarted by industry influence. The strongest of these is the capture theory, which posits that agencies are taken over by the industries they are supposed to oversee. Horwitz criticizes the theory, however, because he says it treats all agencies alike, ignoring their varying histories.

An offshoot of capture theory cited by Horwitz is the conspiracy theory, which argues that regulatory agencies are set up with industry support to serve the industries' ends, thus forming a conspiracy between business and government. Conspiracy is essentially political in its analysis, whereas Stigler takes an economic approach with similar conclusions.

Horwitz finds considerable merit in the positions of Stigler, Peltzman and like-thinking economists, which he labels economic capture-conspiracy theory. In the case of the FCC, however, he notes that the agency serves a variety of regulated groups, which may be in conflict with one another. This could serve to weaken industry influence over the FCC and give it a measure of autonomy.

Horwitz offers two other classes of theory which he says allow for a measure of regulatory agency autonomy. One he calls the organizational theory, which suggests that staff members of the agency see their primary role as regulation, and their interests coincident with the agency, not the industry. The role of the agency in such a setting may be to build consensus and minimize conflict among interest groups. A final theory reviewed by Horwitz is the capitalist state theory, which says that the state is inextricably biased toward capitalism, and regulatory agencies are created when the dysfunctional market cannot regulate capitalistic behavior.

Presenting a new theory of regulation, Horwitz argues that regulatory agencies are in an inherently weak position. They are constrained by a combination of a vague, often contradictory mandate, potential judicial oversight, pressures from Congress and the executive branch, and pressure from industries whose framework existed before the agency. These constraints result in the regulatory agency making decisions by bargaining, which casts the agency in the role of arbitrator or facilitator, not policy-maker.

Geller (1995) describing the federal telecommunications policy making environment, presents a picture very close to the Horwitz theory model: a variety of institutions and agencies which influence policy in various ways, operating in a setting where mandates are vaguely stated and often in conflict.

Faulhaber (1987) reiterates that the economic purpose of regulation in the telephone industry is to prevent what economists call market failure. Market failure is the inability of the market mechanism to assure the efficient allocation of limited

resources. In telecommunications, according to Faulhaber (p. 106), there are two "compelling sources" of market failure: natural monopoly and network externality. Faulhaber and others acknowledge that other considerations besides purely economic ones are served by regulation.²³

The public interest goal of the regulatory authority in a monopoly market is to use substitute means to accomplish the functions usually accomplished by the price mechanism in unregulated markets (Mayo & Flynn, 1988); that is, to drive prices lower than those normally charged by a monopolist, toward marginal cost. Faulhaber (1987) reiterates that the regulator's goal is to encourage prices that lead to greater efficiency. Neoclassical economic theory tells us that the monopolist will set output quantity at the point where marginal cost equals marginal revenue, because that is the point of maximum profit. With the normal downward-sloping demand curve, however, there is unserved demand below the price charged by the monopolist, but above marginal cost. This has two ramifications:

1. Total consumer and producer surplus is not maximized. That is to say, the social benefits could still be increased, even though producer profits might be decreased, if more of the good were produced.

2. To the extent that profits exceed the normal return on capital, excess profits are being realized by the monopolist.

If the regulator succeeds in forcing the monopoly firm to charge less than the normal monopoly price, this will lead to increased consumption at the lower price, and therefore greater consumer surplus, at the expense of some producer surplus. The increase in consumer surplus will be greater than the loss in producer surplus, unless price is set too low. Therefore benefit to society, reflected in total surplus, will be increased.

Ideally, the regulator will be able to force price down the demand curve to the point where price is equal to marginal cost. At such a price, there is no excess demand,

and the firm may still be profitable. At this point, efficiency in the allocation of resources is maximized. (Bailey & Baumol, 1984). Bailey and Baumol posit that the task of the monopoly regulator is to provide the benefits that a perfectly competitive market would provide. These include the preclusion of excess profits, elimination of inefficient firms, absence of cross subsidies, and pricing which encourages efficient allocation of resources according to consumer preferences.

As an alternative to the unrealistic goal of perfect competition, Bailey and Baumol offer the contestable market, which promises comparable economic benefits. The contestable market is one which may be freely entered by competitors, even though the market itself may not be competitive. The threat of competition inherent in the contestable market, they argue, will tend to curb the excesses of monopoly. One of the characteristics of a perfectly contestable market is ease of entry and exit. In economic terminology, entry and exit must be costless. Among other things, this means that a firm must be able to recoup its entry investment when it decides to leave the market. It also implies that no law or regulatory authority will prevent a firm from entering or leaving the market.

Regarding the telephone industry, the FCC, as a major figure in the regulation and policy-making arenas, long presided over a convenient compromise which seemed to serve both public and private interests quite nicely. The FCC for decades monitored a long distance interstate telephone industry almost wholly dominated by American Telephone and Telegraph. AT&T, also the major player in local markets, developed a system of cross-subsidizing local phone service with its monopoly profits from long distance service. This served the national purposes of developing a phone system that went nearly everywhere, was inexpensive enough for most potential demanders, and had a high degree of reliability. Willing partners in the game were state public utility regulatory agencies. As Noam (1994) puts it, government intervention balanced the power between the monopoly suppliers and small users. Empirical work by Teske

(1990) appears to lend considerable support for Noam's evaluation.²⁴ The system was arguably among the best in the world from any point of view.

Compared to conventional telephone, cellular telephone is lightly regulated at the state level. As of 1992, only 12 states even required that retail tariff schedules be filed with state regulatory agencies, and 21 required that wholesale rates be filed (Ruiz, 1994). In many cases, no further action was required before rates were implemented, and the only state which rigorously scrutinized rates was California. The right of the states to review and approve rates was removed in 1993 by an amendment to the Communications Act of 1934, reserving the right to regulate cellular rates for the FCC.

Price Objectives

It is considered axiomatic (though not always true) that lower prices should be considered desirable in a society which tends to assume the dominant viewpoint of the consumer.

From a public policy point of view, the ideal flat price for the consumer to pay for a good or service would generally be the marginal cost of production. Pricing at long run marginal cost enables the producer to cover the additional variable cost incurred in serving a new customer, including the cost of capital, and thus remain a viable business.

Under a regime of flat (undifferentiated) pricing, total surplus (consumer surplus plus producer surplus) will be maximized when price equals marginal cost (at the point where $D = MC$). A price set higher than this point will decrease the number of willing purchasers, leading to a decrease in consumer surplus, although this may be partially offset by an increase in producer surplus due to higher-than-normal profits. If the price is set below marginal cost, either the producer will suffer a loss, or the producer will restrict production, leading to unfulfilled demand at that price, a form of market failure.

Any of these results will reduce total surplus, which is a measure of total benefit to society.

The problem with marginal cost pricing is that in some situations, it may not be sufficient to cover the costs of running the firm. This is very likely in the case of a telecommunications utility, which incurs a large investment before being able to offer the service, and which is likely to have marginal costs which decline throughout the relevant range of operations. Although average costs will continue to decline, they will always be higher than marginal costs. Therefore every sale at marginal cost loses money. The firm cannot remain viable under such conditions.

The firm must operate under what is called its revenue requirement, or more broadly, the balanced budget constraint. That constraint is the revenue required for the firm to be able to cover all of its costs to become and remain viable.²⁵

Alternatives may be possible through various forms of nonlinear pricing. Since two-part tariffs are now standard in the cellular telephone industry, it should be possible to structure these tariffs in such ways as to take advantage of the greater consumer surplus and inelasticity of demand of certain customers, in much the same way as the airline industry. This in turn may make it possible for the producer to sell some production below marginal cost and still not reduce total profits.

One two-part tariff model shifts more of the fixed costs to consumers which have high surplus, thus allowing firms with declining MC to offer service to more consumers at the margin. Since these high-surplus consumers still find that their utility exceeds the price of service, this strategy will not discourage them from continuing to subscribe. The practical effect of such a shift may be twofold: To make service available to customers with less ability to pay, and also to increase the value of service because of the network externality effect. In this manner, the ideal of universal service affordable for every potential user is more nearly fulfilled. This in turn helps to insure

that those less able to pay are not cut off from increasingly vital information services, and that emergency needs of the elderly and the poor are more adequately met.

Telecommunications services are a highly unusual product, in that marginal cost in non-peak periods may have a marginal cost of nearly zero (Mitchell & Vogelsang, 1991). This could create some interesting, socially beneficial possibilities for both vendors and policy makers, because extremely low pricing may be possible without straining capacity or reducing profits.²⁶

Universal Service

One of the long-standing attributes--and traditions--of the American telephone system has been its commitment to provide virtual universal service to homes and businesses. With the help of a complex system of cross-subsidies, developed by American Telephone & Telegraph and sanctioned by federal and state regulatory agencies, the public switched telephone network (PSTN) reached into 93 percent of American households by 1980 (Cain & MacDonald, 1991). Although the rate dipped slightly in the 1980s, it remained above 90 percent, and climbed back to the 93-94 percent range in the 1990s.

The term universal service has traditionally been used in two ways:

1. Service available everywhere, as a result of the Bell system's commitment to provide it;
2. Service available at such a price that virtually everyone can afford it. The term "universal access" has been suggested as more specifically describing such service (Hills, 1989).

Both meanings were eventually adopted, at least tacitly, by regulatory agencies in approving AT&T's policies and practices.²⁷ Having achieved a monopoly in long distance service, and a strongly dominant position in local service, AT&T embraced

regulation as a means of guaranteeing its position and assuring both profits and public acceptance.

Both of the traditional meanings rest on a long-standing consensus of what constitutes telephone service. The National Telecommunications and Information Administration has described this consensus view as "a basic level of telephone service to all, at affordable rates. (NTIA, 1988, p. 285)" This definition includes elements of both traditional views. The Rural Electrification Administration, which has helped bring telephone service to rural areas since 1947, currently defines basic telephone service as one party service with digital stored program control switching, flat rate local service, worldwide toll access, extended area service, directory assistance, emergency assistance and 800 and 900 line access (NTIA, 1988). This definition has evolved. In 1949, REA defined basic service as a maximum of eight party lines, automatic dial switches, automatic selective ringing, 24 hour service and area coverage (NTIA, 1988)

NTIA argues that the traditional view of telephone service as simple voice communication is too narrow to cover changing needs and new services. In the NTIA 2000 report, the agency offers the redefinition of basic as simple voice plus a package of services that could be provided at, or close to, zero additional cost. An example would be Touch Tone service, which costs no more with modern switches than rotary dialing. The other precept of the report is that services with costs significantly greater than zero would be offered with prices set at or close to the cost of providing them (marginal cost, in economic terms). Since NTIA strongly endorses unbundling and deregulation of prices, the report is counting on the efficiency of the market to assure equitable pricing. Opening local exchange service and cable systems to competition will encourage technological development and the introduction of advanced services. This should benefit all users, including those least able to afford service (NTIA, 1988). Telecomm 2000 also endorses subsidizing phone service for low-income households.

Dervin (1982) expresses concern about equal access to all communications systems. She makes the point that each individual uses information in a unique manner, so individuals must have full two-way communication to interact with other members of society. Such interactivity is more feasible in a point-to-point communication system like telephone than in mass communication systems. Thus Dervin's argument can be taken as a strong endorsement of universal service.

Several economic problems inherent in universal service are evident. In promising to provide telephone service almost anywhere, the conventional telephone system has to string wires in sparsely populated rural areas as well as dense cities, involving much higher capital expenditure per rural subscriber. Someone would have to pay the cost of such investment, and overall, the system would have to earn a satisfactory return.

The challenge of providing service to all who desire it implies deriving revenue that will yield a satisfactory return, even though some subscribers could not afford to pay a market-based or cost-based rate. Both problems necessitate subsidies of some type, leading to the classic cross-subsidy situation.

The subsidies which developed were of four types (Kahn, 1984):

1. Long distance rates, until recent times, were used to subsidize local service. The subsidy from interstate toll calls was estimated at \$7 billion in 1981, which averages to \$7 per month for every telephone line in the country. Kahn notes that intrastate toll rates would have added several billion more to that figure.
2. Businesses have subsidized residential subscribers. However businesses pass these costs along to their customers, so this subsidy reappears as a hidden tax on consumers, irrespective of telephone use.
3. Urban customers subsidize rural customers, as noted earlier.

4. Customers making local calls during off-peak hours subsidize those who do their calling during peak periods, because peak loads dictate the capacity required in the system, which all help pay for.

A fifth type of subsidy could also be defined under flat rate pricing. Customers who make few calls could be regarded as subsidizing those who use the system heavily, since all pay the same rates.

As some of these subsidies disappeared and local rates increased substantially during the 1980s, there was some predictable attrition in telephone market penetration. Despite the increase in local rates and imposition of long-distance access charges, the dip in the household penetration rate was short-lived. In 1980, the national residential penetration rate was 93 percent. The penetration rate dropped to a low of 91 percent early in the decade, then climbed back to 92.9 percent by April 1988 (Cain & MacDonald, 1991). The penetration rate was back in the 93-94 percent range in the early 1990s.

This relative stability in a period of rising rates is attributable to three factors (Cain & MacDonald, 1991):

1. Numerous studies indicate that telephone service is relatively inelastic. So customers tend to retain the service if possible even when rates rise steeply.
2. The prosperity of the eighties moved households out of the poverty bracket at a rate comparable to the rise in phone rates.
3. Local measured service (LMS) was increasingly available in this period, encouraging some households who found flat rate service rising beyond their budgets to switch to service with a lower access charge.²⁸

The access fee is generally conceived as covering the non-traffic-sensitive (NTS) portion of the costs of providing phone service. Such costs are about the same, within a given exchange or community, for all users in a class, such as residential. The traffic-sensitive (TS) costs are charged at a rate which varies with usage.

Advocates of the universal service concept who want to provide more access for the poor generally favor a subsidy for the access fee, which is expected to cover the NTS costs. Subscribers on limited incomes, it is reasoned, can control the amount of calling they do, and therefore keep TS-related charges down by choice. So the question often comes down to the source of the revenue to subsidize the access fee.

Kahn (1984) argues that much of the access fee argument could be dismissed by examining the nature of the NTS costs involved. In older areas, where the poor tend to be congregated, the cost of access is largely "embedded" costs of providing access to existing structures. That is, the lines and switches are already in place, as is much of the inside wiring. The actual cost of hookup is low. Subscribers requiring new construction, he suggests, should pay a much higher access fee reflecting the actual cost of providing access. Charging the same access fee to all customers means that new, higher cost subscribers are being subsidized by older ones.

A more frequently reported debate pits those who think that access charges for the poor should be subsidized by other telephone subscribers against those who feel the subsidy should come from general tax revenues (see Gillis, Jenkins & Leitzel, 1986; Snowberger, 1990). This debate carries political as well as economic overtones.

Proponents of subsidization from other system users rest their economic argument in part on the existence of network externalities (Gillis et al., 1986; Snowberger, 1990). This is the attribute of communications networks which makes the network more valuable to existing users as more users are added. Thus the addition of new subscribers--even low income ones--increases the value of the network to current users and offsets to an extent the increase in cost due to a tax to subsidize access.

Couched in different terms, the marginal social cost of adding a subscriber is less than the marginal production cost, because of the benefit from the network externality (Willig, 1979; Gillis et al., 1986). It is even conceivable that the increase in

consumer surplus attributable to network externality exceeds the actual cost of hookup at the margin.

From the political point of view, general tax assistance for the needs of the poor tends to be unpopular. Although it could be argued that a degree of positive network externality accrues to all society--not just others on the telephone network--the political process may not accept that argument as justification for a general tax subsidy.

At least one study indicates that price elasticity is significantly higher among the poor than among the more affluent (Cain & MacDonald, 1991). This indicates that if a price discrimination strategy is used, higher prices can be charged to those who are not poor, because they will not drop off the system. The poor, however, need low prices to make phone service attractive.

An additional burden associated with access is the up-front deposit which telephone companies frequently require from new subscribers. This falls most heavily on the poor, because local exchange companies (LECs) are more prone to waive the requirement for those who have a record of paying phone bills regularly and who have a good credit rating. LECs would be unlikely to forego this requirement, in view of fears that the poor might be less reliable about paying their bills than those with higher income.

Technological considerations may influence conclusions regarding the efficiency of local measured service pricing, because of the added costs of metering and billing. Early studies indicated that LMS increased efficiency, but a 1987 study concluded that technology had reduced the cost of local service to the point where LMS no longer increased overall efficiency (Wenders, 1990).

Universal service may be threatened by a fully competitive phone environment, Noam (1995) and others argue. There is no longer any incentive for phone service vendors to offer lower price service to protected classes of users, and there is no ready source of funds for such cross-subsidies. Noam suggests that government set up a

mechanism to subsidize the poorest class of customers to assure that they get adequate service. Dordick (1995) and Noam suggest several ways that this could be accomplished.

In the Telecommunications Act of 1996 (S. Res. 652, 1996), Congress attempted to meet the threat to universal service by assuring quality services at reasonable rates, access to advanced services in all regions, rates in rural, insular and high-cost areas reasonably comparable to those charged in urban areas, contributions in support of such services from all providers of telecommunications services, and access to advanced services for schools, health care providers and libraries. The Federal-State Joint Board on Universal Service made recommendations in November 1996 to implement the universal service principles of the act. Among those recommendations were expansion of the Lifeline and Link Up programs for low income consumers, subsidies for rural, insular and high cost service providers, rate discounts for schools and libraries, and creation of an administration to collect the support subsidies from interstate telecommunications carriers and distribute those subsidies to the recipients (FCC NEWSReport No. DC 96-100).

Bypassing the Local Loop

Bypass of, and competition with, the local traditional telephone providers became a full reality with the passage of the Telecommunications Act of 1996. The act opens up the local market completely to competition from cable television firms and long distance telephone vendors. The tradeoff is that the local phone companies are now authorized to offer a wide variety of services formerly denied to them.

The response was immediate. Four days after President Clinton signed the bill, Southern Bell executives placed a symbolic long distance interstate call using only Southern Bell facilities. No longer would it be necessary for the LECs to limit

themselves to interconnections with long distance providers. The closed local loop, as we have long known it, may become obsolete.

The possibility that new telephone-related technologies would rearrange the traditional architecture of the telephone system has been the topic of considerable discussion. Kahn (1984) foresaw an era in which alternative technologies would create true competition for the established telephone system. He was writing shortly after the court-approved dismemberment of AT&T, and some of the technologies on the scene today were little more than a glimmer in futurists' eyes. He anticipated, without knowing the directions in which technologies would develop, that local competition was coming and was probably inevitable. Kahn predicted that satellites, cable, cellular radio and fiber optics would provide alternatives to conventional wireline telephone loops which might prove competitive under certain circumstances. Specifically, he cautioned that the new channels would be cost-effective in sparsely populated areas, and would reduce the cross-subsidies extracted from users in more urban areas.²⁹ We are already seeing that second prediction come true.

Kahn saw these trends as beneficial, because they can result in lower overall costs of service, and greater economic efficiency. In particular, he lauded the trend away from the traditional pattern of long distance service subsidizing local service.³⁰

Bolter, Duvall, Kelsey, and McConnaughey (1984) foresaw that cable TV could be substituted for local phone loops over the long term, and the Telecommunications Act of 1996 makes this legally possible. The two-way capability of new and upgraded cable systems would seem to make voice and data transmission a relatively easy task. With restrictions now gone, the door is open for the cable firms to upgrade their systems and branch out into phone service, and many seem to be preparing to do so. Some pilot projects are already in place and plans for full service have been announced by at least one firm.

AT&T, which gave up its dominance of local telephone service under the divestiture agreement of 1982 (MFJ, 1982), has been positioning itself to re-enter the local market via cellular. Its acquisition of McCaw Cellular provides the means to bypass the local loop for cellular customers. Bolter et al. (1984) note this possibility in their Bell Atlantic case study. In the situation of Bell Atlantic in Maryland, District of Columbia, and Virginia, they observe that the corporate parent was developing the cellular alternative which could compete against its own LEC, Chesapeake and Potomac Telephone.

The 1983 FCC report (cited in Bolter et al., 1984) reported that AT&T, after divestiture, would have a great capability to provide local bypass and direct access to its interstate long distance network. Before divestiture, such a move would have served no purpose, as it would have only diverted business from AT&T's own regional Bell subsidiaries. Rohlfs and Gilbert (1990) note that the inter-LATA (long distance) communications industry will be as innovative as regulation permits, and AT&T, as the dominant firm, will benefit fully from the trend. Therefore, AT&T should lead in innovation to counter its declining share of the long distance market.

Buxton and Cartwright (1990) report that AT&T probably has excess switching capacity as a result of divestiture and competition, giving it a special motive to seek bypass customers. Supporting this conjecture is the fact that AT&T has extra transmission capacity on fiber optic cable, and higher transmission rates are increasing this capacity. Since transmission costs are relatively insensitive to distance, the marginal cost of adding circuits for bypass customers may be very low. AT&T is in a position to compete with local providers at very low additional costs to the company.

For business users of local phone service, the firm's price elasticity is increasing in response to more numerous bypass alternatives (Evans & Garber, 1989). The increased elasticity in turn means that appropriate prices for business users are falling.

This makes it probable that state regulators will lower business phone prices and increase residential prices as a response to bypass threats.

Because of the ubiquity of the local phone network, there have been no firm predictions that any particular technology would completely replace it. Nicholas Negroponte, who has been predicting the "Negroponte shift" for several years, has perhaps come the closest to such a prediction (Negroponte, 1993). Negroponte is predicting that eventually, video broadcasting will be removed from the airwaves and will be carried entirely on cable. This will open up a lot more spectrum for the transmission of point-to-point communication, which opens the door to some form of radio transmission entirely or substantially replacing wireline technology for the PSTN.

Regulation and Public Policy

Regulation is but one ingredient in the larger milieu of public policy, albeit a major ingredient in some industries. As the federal government, with prodding from the Clinton administration, pursues and enlarges its positive, activist role in developing a national information infrastructure (NII), the relative importance of regulation may be reduced. However, this reduction in role may never completely eliminate the perceived need for regulation in telecommunications in general and telephone in particular. Even some of the strongest proponents of deregulation concede that the telecommunications market may never be effective enough to make regulatory oversight unnecessary.³¹

Noll and Owen (1983, pg. 161) argue that "there ought to be a presumption--open to rebuttal--in favor of competitive market approaches for achieving social control of business." In a similar vein, Breyer (1982, pg. 185) recommends that the least restrictive approach, which "would view regulation through a procompetitive lens" would help reduce the problems associated with regulation. Breyer endorses the preference for competition. The U. S. Congress showed its agreement with this position when it passed the Telecommunications Act of 1996, which substantially

reversed some long-standing policies of the FCC and modified the Communications Act of 1934. This landmark change in the law came after several years of political stalemate regarding the deregulation of telephony. The FCC on Aug. 1, 1996 adopted a set of rules intended to implement the local competition provisions of the 1996 act (FCC NEWSReport No. DC 96-75).

Garcia (1995) argues that the political arena is the best place to choose among competing values. Economic efficiency, she and others point out, may be a worthy motive, but it is not the only motive in public considerations. Ironically, the political system--Congress and the President--was the venue which this year made the value decision to allow the lightly regulated free market and presumably economic efficiency determine the future development of the American telecommunications system. Conflicts between values and ideologies are cited by Noll (1989) as a fundamental reason for continuing policy disagreements. He contends that the different centers of responsibility each tend to focus on only part of the problem and may even deny the existence of conflicts.

The regulatory and political arenas are not neat, discrete venues. Geller (1995), in a critical appraisal of the U. S. policy making environment, lists eight power centers which are involved in making telecommunications policy: Congress, the FCC, National Telecommunications and Information Administration, State Department, U. S. Trade Representative, Justice Department, Appellate Courts, and State Public Utility Commissions. This fragmentation of power, he argues, effectively prevents the nation from having a vision or unified policy approach such as other nations have.

Entman and Wildman (1990) make a persuasive argument that economic efficiency considerations are inadequate for the media policy debate. They posit that limited diversity of ideas in the media represents a failure on the part of consumers to demand and seek out greater diversity. They go so far as to suggest that the demand for ideas in mass media may be quite low, and inelastic, given the difficulty for

individuals to survey and absorb a wide range of ideas. However, except for a call to market school adherents to broaden their perspective, Entman and Wildman offer no positive suggestions as to how to redefine the policy debate to give proper weight to noneconomic considerations.

The question of fairness is sometimes raised in discussions over access to telephone and other information services. Zajac (1978) reviews the literature on economic justice, and concludes that theory in the field is in such an early state of development that it is little help to the policy maker. Mitchell and Vogelsang (1991) summarize four different concepts of fairness, which they observe are at least in part incompatible with one another. It is impossible, they conclude, to satisfy the constraints of all four concepts with one solution.

Fairness and justice are elusive terms--so subjective and value-laden that they do not lend themselves readily to discussion in an objective setting. When applied in a situation involving public services and regulatory objectives, fairness can usually be reduced to the problem of providing wider access to services which are considered vital or at least very important. Given that well over 90 percent of all American households find it worthwhile to have their own telephones, it is not difficult to justify the "very important" label for telephone service. Add to that the fact that in emergency situations, telephone service can indeed be vital, and it becomes easy to justify efforts to extend service to those of limited means, pursuing the old ideal of truly universal service.

We will continue to examine the problem under this assumption: It seems socially desirable to provide basic telephone service to as many homes as possible in a developed society.³²

Following that line of reasoning, the goal is to provide service to those who are well down on the demand curve, below the point at which it intersects with marginal

cost, which would normally be the minimum price at which the firm could sell, or the price level dictated by the vendor's revenue requirement, whichever is higher.

Customers below this point will have to be subsidized in some manner if society wants them to have service. The subsidy may come from general tax revenues, or from a shift in resources through the pricing mechanism. Such a resource shift may be accomplished through regulatory action, or it may be possible to accomplish it voluntarily by nonlinear pricing, including two-part pricing. It should be noted, however, that the voluntary solution may be difficult to achieve in practice in a duopoly, because of the likelihood that cream-skimming will become possible in price classes which are the sources of the subsidy.

A number of new public policy objectives for telecommunications are gaining support, joining some older ones which have not disappeared with the changes in technology and industry structure.³³ Although there is no consensus on many of these objectives, the following have been suggested:

Traditional objectives

1. Universal service
2. High quality of service
3. Encouragement of improvement, innovation and evolution

New and developing objectives

1. Diversity of ownership
2. Physical interconnectivity
3. Public affairs objectives, including the free access to appropriate information and encouragement of wider participation in government
4. Uncensored information flow
5. Prevention of oligopolistic behavior by integrators and carriers
6. Competition at all levels

7. Continuing rate regulation of carriers with market power
8. International symmetry
9. Development of international standards acceptable to all
10. Elimination of restrictive business practices internationally
11. Development of appropriate privacy protections
12. Balance of intellectual property protections between producers and users
13. Support for technology development, especially for small organizations
14. Training of workers for information professions.
15. Opening of policy making process to democratic participation
16. Participatory fairness in access to new services.³⁴

Obviously, many of these are of limited relevance to cellular telephone and the study of duopoly market structure. However, all of these objectives, if adopted widely, could shape the broader environment within which cellular operates.

From the limited perspective of cellular telephone, the following policy objectives from the previous list could be considered relevant:

1. Universal service (in terms of equal and affordable access)
2. High quality of service
3. Encouragement of improvement, innovation and evolution
4. Physical interconnectivity
5. Prevention of oligopolistic behavior by integrators and carriers
6. Competition at all levels
7. Rate regulation of carriers with market power
8. Development of appropriate privacy protections
9. Participatory fairness in access to new services

The first two are traditional values of the U. S. telephone system and its regulators, and are equally applicable to cellular systems. Some might argue that universal service is not relevant to cellular, because mobile service is not a necessity. However, there is evidence that airwaves technologies will supplement or extend the range of wireline service in the future, and cellular could be a cost-effective alternative. Cellular is also beginning to bypass the local networks for long distance access. Objectives 3 and 4 are both technical and economic considerations. Continuing shifts in market structure and relative market power of participants draw attention to objectives 5, 6 and 7. Objective 8 in the list is related to both political principles and technological possibilities, since it has been possible with analog technology to eavesdrop on cellular transmissions. The final objective has both economic and political implications.

There is also some overlap between objectives. For instance, if competition at all levels is achieved, then oligopolistic behavior is forestalled, and market power is not unduly concentrated.

Several of these objectives are specified in the Telecommunications Act of 1996, which makes them U.S. policy by law. Although the intent of the 1996 act is to substitute, in large part, free market forces for regulatory control, it is clear that Congress did not trust economic pressures alone to accomplish all of the desired public policy goals.

To summarize: The recent history of mass communication shows a long term trend toward fragmentation and specialization, resulting in mediated communication which more and more resembles face-to-face communication. Telephone technology, including cellular, is a vital component, and is utilized for both informational and social purposes. Economic theory indicates that competitive conditions are likely to encourage efficient use of resources as well as favorable prices to consumers. The duopoly market structure of the cellular industry offers an unusual chance to study how

well duopoly encourages competitive behavior, as well as the effectiveness of duopoly structure in achieving widely accepted public policy objectives for telephone service.

Chapter 3 will present the research methodology that will facilitate assessment of the economic problem and analysis of that assessment in terms of the public policy objectives.

Notes

¹ See Merrill and Lowenstein (1971), Maisel (1973) and Aumente (1989) for several perspectives on the changing media landscape.

² Dutton, Blumler and Kraemer (1987) note that new technologies are also decentralizing the media by fostering horizontal communication between users by point-to-point channels. They see this as a democratizing trend, in the tradition of Pool. New media, they observe, allow for asynchronous communication, provide an abundance of channels, and eliminate many transmission barriers. The result, they argue, is a media system more closely resembling the face-to-face communication patterns which predominated before the 19th century.

³ Over the past several centuries, the nature of the communications media in relation to their audience has gone through several shifts.

Prior to the invention of printing, communication was a one-to-one or one-to-group process. Although there were various forms of written communication for thousands of years, production was slow and dissemination limited. As Pool (quoted by Schramm, 1988), put it: "The fact that a printer could produce on the average one volume a day, while the copyist produced two a year, made change inescapable." Printing increased the velocity of the dissemination of information many times over. However, the influence of printed material was limited for several centuries by the inability of most people to read, as well as the relatively high cost of printed material.

The coming of widespread literacy changed that. In the U.S., education--and the resulting literacy--was a national priority from the early days. By the early 19th century, the number of people who could read was growing fast. As a result, newspapers became the first mass medium, in the fourth decade of the 19th century.

For more than a century, newspapers were the archetype of the mass medium. They grew in numbers, circulation, influence and profitability until by the 1890s, publishers could stir the country to war. There was not only profusion but diversity. Major American cities had several newspapers, often with different political biases and appealing to different demographic groups. A vigorous foreign language press served the needs of new arrivals.

The hegemony of the newspaper was not challenged until well into the 20th century. Magazines had grown and thrived, often serving specialized interests as well as general audiences. Radio, starting in the 1920's, began to offer an alternative source of news and current information, challenging a major role of the newspapers.

Three decades later, television burst on the scene and won huge audiences. Newspapers, which had been declining in numbers, but not overall circulation, since the 1920s, felt the impact. Worse hit were radio and magazines. Since a major appeal of TV was entertainment, it undercut magazines and radio, which appealed to the same consumer need. Magazines and radio reversed course and developed largely into specialized media serving niche audiences. Magazines often appeal to very narrow interests which may be geographically scattered; Radio stations are limited geographically, but tend to serve well-defined demographic groups in their listening range.

The emerging pattern gave rise to what Merrill and Lowenstein (1971) termed the Elite-Popular-Specialized curve (EPS). They hypothesized that the media in any country advance from elitist to popular to specialized in appeal. In the U.S., the media were elitist until the combination of literacy and moderate affluence made newspapers widely available starting in the 1830s. In many Third World countries, poverty and illiteracy restrict most media to the elite to this day. Once the masses have access

to media, the media enter the popular stage. Mass media attract large audiences and acquire considerable influence. The media themselves tend to cater to the lowest common denominator of the population. Merrill and Lowenstein noted that in 1971, most developed countries were in the popular stage of media development. They also noted that radio and visual media may leapfrog over illiteracy, provided the population has the means to afford them. The transistor radio, they said, became a popular medium in underdeveloped countries when few could read. Pool (1983) argued that new technologies and improvements on old ones were providing access and means of expression to the less affluent, encouraging economic and political development.

Media in fully developed countries can enter the specialized stage, characterized by many individual media appealing to limited audiences. Merrill and Lowenstein said that this stage requires the confluence of four factors: higher education levels, affluence, leisure time, and large population. At the time of their writing, they judged that only the U.S. was on the verge of the specialized phase.

Maisel (1973) tested the EPS theory by studying growth rates of the various American media during the 1950-1970 period. He found that the mass media had been declining relative to the economy, while specialized and individualized media such as higher education, telephone and mail had higher growth rates. Maisel also noted the increasingly specialized nature of magazine and radio content.

In the early 1970s, few researchers could foresee computer networks, data transmission by telephone lines, facsimile and other technological advances which would facilitate the specialized/individualized nature of the media. The two decades since have seen the emergence of various new communication technologies which we might label media.

In an age of increasing choices, the media user is no longer simply the recipient of standardized messages, Maisel argued. With the advent of more specialized channels, the individual has access to powerful media tools and a wide range of communication content. Researchers, he says, should give more attention to how individuals use the communications resources, and how this richness of choice affects the user. A number of studies since then have contrasted the use of various media by measuring the personal involvement of the user. Thus, print media generally require more effort on the part of the reader than video media.

Aumante (1989) discussed the mass media developments and labeled the trend demassification. He emphasized that the new electronic media not only encourage specialization, they permit two-way communication in ways not possible earlier. Although he saw some social and legal problems in this continuing trend, he was elated about the possibilities for an enlargement of the total base of news and information, as well as the possibility for providing better service for specialized interests and niche groups.

⁴ Other researchers have found evidence that social purposes are important among non-business telephone users. Demographic studies conducted by phone operating companies reveal that residential telephone usage is highest among families with teenage children which have moved from one neighborhood to another within a metropolitan area (Mayer, 1977). Other demographic groups with high usage were women between the ages of 19 and 64, men over 65 who are not heads of household, and girls between 13 and 18. From the age and gender of the heavy user groups, it is safe to surmise that social calling heavily influences usage in residential service.

Use of the phone is tied to the need for "psychological neighborhood" theorized by Aronson (1971). Wurtzel and Turner (1977) confirm this in their study of a New York neighborhood during a period when all phones were out of service. Many people feel a need to keep in touch with others who are not in their immediate neighborhood, and the phone is the ideal instrument.

O'Keefe and Sulanowski (1992), employing the uses and gratifications paradigm to examine the motivations of telephone subscribers, find four broad types of gratification factors which personal telephone use satisfies: sociability, entertainment, information acquisition, and time management. Of these, sociability was by far the most significant.

⁵ An interesting business-related observation very relevant to cellular telephone: In the development of the modern city, the phone has had two important and opposite effects, according to Gottman (1977). By facilitating a geographic split between clerical and production operations, the phone helped make urban office concentrations possible. That is, office functions could be located in the central city business district, with manufacturing facilities elsewhere. But it has also permitted office jobs to be separated

from the main workplace, facilitating the more recent trend to office decentralization and, more recently, telecommuting.

⁶ See the useful discussion in Fiske (1990) on the two broad approaches to the study of communication. While we would not disagree that the study of semiotics is equally as valid and rewarding, for our purposes we find the channel or system perspective more appropriate.

⁷ Schumpeter (1934) stresses the role of the entrepreneur in the innovation process. He regards innovation as the application of a new idea or invention, and includes a fairly wide range of activities in what he considered innovative behavior, including new types of organizational structure, and the opening of new markets. The entrepreneur, in Schumpeter's view, seeks the rewards of high profits for his innovation, but those profits are destined to diminish as others emulate the innovative tactics and competition drives prices down. The entrepreneur adds value through his innovative activity, and for awhile reaps a producer surplus. Eventually this surplus is shifted to the consumer by normal market forces.

⁸ The literature contains examples of some innovations which have not followed this bell-shaped pattern, most particularly television, which was adopted in extraordinarily rapid fashion in the early 1950s (Fullerton 1989c). It can be argued that pent-up demand and regulatory delays contributed to this unusual pattern, however, by delaying the initiation of diffusion. More recent work has suggested that the videocassette recorder/player is another example of a product introduction with an exceedingly short adoption period.

⁹ Indeed, the diffusion process may be seen solely in terms of communication. Monk (1992), conceptualizing diffusion this way, limits the concept of diffusion to the distribution of technological information leading to adoption decisions. He thus sees information as an economic resource, and argues that communication modes or channels constitute the principal mechanism of technological change.

¹⁰ See the discussion of the AM stereo case in Klopfenstein and Sedman (1990).

¹¹ Antonelli (1989) identifies four groups of influences, which he calls approaches, which may provide insight into the diffusion of communications technology:

1. Investment and economic conditions;
2. Epidemic imitation;
3. Dynamics of supply forces (equilibrium); and,
4. Role of externalities.

Accelerator approach: Investment determines the speed of diffusion. Investment, in turn, is controlled by macroeconomic conditions such as availability of financial resources, interest rates, prediction of future demand, age of existing capital goods, and relative profitability of other new investments.

Epidemic approach: Epidemic imitation occurs when potential adopters see benefits realized by early adopters of a technology. This is a snowball effect, in which adoption begets more adoption. The importance of telecommunications tariffs in such a situation is likely to be small, because collective learning and consequent purchase of equipment are the driving forces.

Equilibrium approach: Supply economics are given more weight in Antonelli's third approach. It accepts collective learning as a factor overall, but suggests that cost considerations are instrumental in the timing of the adoption by each user. The user's supply curve may be shifting, in response to new awareness, but costs must come down to the point where purchase is rational.

Externality approach: The influence of externalities is the awareness that a communications network becomes more valuable as it grows. The very expansion of size associated with new users means more potential connections and greater benefits, increasing what Antonelli calls user value. This is axiomatic with technologies like telephone systems, which can only be used by network subscribers.

Antonelli's third and fourth approaches support the critical mass concept (Allen, 1988), which posits that when a communications network technology achieves a critical level of market penetration, further growth will be self-sustaining.

In the particular case of telecommunications, Antonelli argues that transmission costs are becoming less and less significant because of two factors:

1. The diffusion of what he calls information technology (distinct from networks), such as fax machines and computer interfaces, is a strong driving force for the use of telecommunication facilities;
2. The benefits of telecommunications are much higher than the prices. This has the effect of creating unusually high consumer surplus, the consumer equivalent of rents on the supply side.

Recent experience emphasizes the second factor, because transmission costs are dropping in real dollars. This is happening in part because of the effects, however slow, of the AT&T breakup and consequent increase in competition. Some economists have argued that the AT&T breakup has had two opposite effects which influence prices: Competition depresses prices in the short term due to profit margins being squeezed and adoption of short-term cost-savings; however in the long-term, reduced expenditures in research and development may prevent or delay some technological improvements which could further reduce costs.

¹² The founders of Sony Corporation, certainly a world leader in consumer electronics, are said not to have believed in market research. Co-founder Masaru Ibuka was quoted as saying in 1980, "You can't research a market for a product that doesn't exist". (Rosenbloom & Cusumano, 1987).

¹³ This model, occasionally with slightly different terminology, is presented in leading textbooks on consumer behavior and marketing, such as Hawkins, Best, and Coney (1986), Cunningham, Cunningham, and Swift (1987), and Peter and Donnelly (1995). It is the centerpiece of the more comprehensive, oft-cited model of consumer behavior presented in Engel, Blackwell, and Kollat (1978). The latter authors, in turn, trace the roots of the decision-making portion of their model to John Dewey in 1910. A good review of consumer behavior models is found in Schiffman and Kanuk (1987), Chapter 19.

¹⁴ Bailey and Baumol (1984) use the concept of contestability for analyzing the attribute of competition within markets. A contestable market conceivably could be a monopoly or oligopoly when operating most efficiently, but also a market which other firms could enter if its existing firms are inefficient or are earning excess profits. In either case, new firms could enter the industry and earn normal profits while charging lower prices. Inefficient firms would be forced to operate more efficiently or leave the industry, and competition would push prices toward efficient levels. Two conditions, however, are necessary for contestable markets: Freedom of entry and exit, and a pool of firms able to enter such a market. The threat of entry, Bailey and Baumol argue, constitutes a pressure for firms in a market to price at near-competitive levels. Bailey and Baumol note that contestability precludes or minimizes cross-subsidies, a fear that regulatory agencies and consumer groups often express regarding allowing firms to operate simultaneously in both regulated and unregulated industries. Cross-subsidies can only come from excess profits derived from higher-than-marginal prices, which are difficult to sustain in a contestable market.

¹⁵ Shepherd argues that the constant tinkering with fares does not reflect competitive behavior on the part of the airlines, but rather a strategy to fill seats by utilizing the principle of elasticity. Shepherd claims that overall, airline fares are stable, indicating that increasing concentration in the industry has enabled the carriers to hold their fares at high levels.

¹⁶ Kahn (1970) characterizes such a situation as differential pricing, not price discrimination, because of the different cost basis. However the phone customer, perceiving equivalent utility, may not see it that way. Elsewhere, Kahn notes that the cost of serving two customers is never identical, except by chance.

¹⁷ Various attempts by niche airlines to enter the industry and take advantage of cream-skimming opportunities are reported by Shepherd (1990). The data show that the price cuts which ensued resulted in additional traffic on the routes involved. In most cases, however, the major airlines eventually forced

the new operators out with their superior financial resources. This reinforces his argument that for the airlines, discriminatory pricing is a tactic to fill seats, not for competitive purposes.

¹⁸ Whitcomb observes that much more effort seems to have been expended defining and explaining the concept of externalities than in studying actual cases. In recent times, societal concerns for the environment have prompted some economic examination of environmental issues as externalities (see Davis & Kamien, 1972). In environmental concerns, scholars and critics concentrate on the costs of activities in terms of harm to the environment (and hence society), for which the party responsible is not charged.

¹⁹ Willig acknowledges a problem quantifying the utility--positive or possibly negative--which might be ascribed to incoming calls. Some incoming calls, such as unwanted sales calls, may represent a negative utility to the subscriber. This is difficult to identify and reflect in the utility function and related price structure.

²⁰ Curien and Gensollen (1990) find that there are three points of supply/demand equilibrium in the growth curve of a telephone network: One at zero, where a nonexistent supply generates no demand; one at the market saturation point; and one is at the point of critical mass, beyond which the network will continue to grow by its own momentum. The zero point and saturation equilibria are stable, while the critical mass point is an unstable one.

²¹ Market structure has a great influence on the incentives to standardize and the standard-setting process. On the buyers' side, a fragmented market will be unable to bring concerted pressure on suppliers to adopt a common standard and thus reduce buyers' costs. Buyer concentration, conversely, increases the pressure on sellers to standardize (Lecraw, 1984; Sirbu & Zwimpfer, 1985). A comparable pattern holds true on the sellers' side. A dominant firm can take the lead and set de facto standards, which smaller firms are likely to follow. Lecraw (1984) ascribes this tendency to the dominant firm's desire to use standards to extend market power. A fragmented sellers' market may prevent coordination and thus retard standardization. A market with a small number of sellers of similar size may resist common standards in order to preserve each firm's market power (Sirbu & Zwimpfer, 1985).

²² Farrell and Saloner (1986) posit that early standardization is more desirable than late, if the decision will be the same, as an early decision removes the incentive for purchasers to wait, and encourages early adoption of the technology. They note, however, that an early decision may preclude a later optimal decision, and that an early choice may be difficult to change. Standardization can have anticompetitive effects (Braunstein & White, 1985; Farrell & Saloner, 1986). Standards may be used to manipulate a market or discourage entry. A large firm has a great deal of power to adopt a standard or reject it, and a dominant firm can cause a superior standard to be ignored. If the firm which is large enough to exercise leadership perceives that a decision will favor it and not its competitors, it has the power to harm rivals. If all users would be better off with a particular standard, they will all switch.

²³ Concise and lucid reviews of the regulatory environment will be found in Faulhaber (1987) and Noll (1989). Both go into basic theories and patterns of regulation, then extend them to the telephone situation.

²⁴ Teske (1990) examines regulation of the telephone industry on the state level to test theories of regulatory decision-making in a political science perspective. He formalizes the regulatory decision-making process (p. 28) as

$$\text{Regulatory Change} = f(P_1, P_2, \dots, P_i; RS; RA; CT)$$

where

$P_1 \dots P_i$ represent the power of interest groups 1 through i ;

RS is regulatory structure;

RA is regulatory attitudes; and

CT is contextual (economic and technological) conditions

Teske also formulates the strength of interest group coalitions S as the ratio between groups in favor of a policy change (Pi PRO) and those against (Pi CON):

$$S = \text{Sum of Pi PRO} / \text{Sum of Pi CON}$$

If $S = 1$, the interest groups are in equilibrium; If $S > 1$, the power ratio among the interest groups favors change. If $S < 1$, the power ratio favors the status quo.

According to Teske, most explanatory theories of deregulation fall into one of two schools:

1. Interest group theories. These explain the behavior of regulatory agencies by evaluating the relative power of interest groups. As political science theories, Teske says such theories may be considered pluralistic.

2. Institutional theories. These include theories regarding regulatory structure, political influences and predominant attitudes or ideology. Thus institutional theories ascribe regulatory decision-making to both regulatory structure (RS) and regulatory attitude (RA) in the Teske formula.

In the case of state telephone regulatory agencies, and the FCC where telephone issues are concerned, Teske concludes that the power of interest groups is approximately balanced, canceling each other out. This conclusion would also eliminate Stigler's capture theory as a means of explaining recent telephone policy decisions in general. This conclusion is consistent with Peltzman's first conclusion regarding the probability of capture, except that Peltzman provides for only two interest groups, while Teske sees the possibility of many. As an example, Teske cites the many FCC decisions in the 1970s which went against the interests of AT&T, showing that the FCC in that period definitely was not captured by AT&T as a representative of predominating telephone industry management.

On the basis of statistical analysis of empirical evidence, Teske concludes that regulatory attitudes and contextual conditions (factors RA and CT) account for very little variation in state decisions regarding telephone policy. Analysis of the data confirms that regulatory structure (RS) is the primary influence on state policy in this industry, according to Teske. Regulatory structure includes such elements as the regulators themselves, their staffs and relations with state legislators.

Teske suggests that regulatory attitudes may be reflected in regulatory climate, then concedes that he has been unable to find an appropriate variable to reflect regulatory climate. He deals to a limited extent with attitude and climate in analyses of anecdotal evidence in case studies, but not in an objective statistical analysis of data.

²⁵ For a more thorough discussion of the marginal cost deficit problem and the use of subsidies to cover it, see Berg and Tschirhart (1988), pp. 44-51.

²⁶ Peak periods are subject to change with changing habits of usage, and thus peak load pricing norms may change. Recently, evening Internet usage has been clogging up phone networks in affluent residential areas, according to phone company and BellCore officials. The problem is reported to be most severe in California and East Coast metropolitan areas (Internet traffic jam?, 1996)

²⁷ The universal service tradition, which became an AT&T principle, and national policy by consensus, traces to Alexander Graham Bell. As early as 1877, a year after he patented the telephone, Bell was talking about how a telephone would become indispensable in every home (Dordick, 1990). In a letter to British investors in 1878, he envisioned a network of telephone lines as pervasive as water mains and gas lines. The network, he said, would connect telephone head offices in different cities, so people could converse at a distance (Pool, 1977).

Theodore Vail, the man who built AT&T into a nationwide system, referred to universal service in the 1910 AT&T annual report, but his vision seemed to have been somewhat different from Bell's. Vail's statement implied that the Bell system would cover the entire country, "extending from every door to every other door" (Dordick, 1990).

²⁸ The long-standing proposal to switch from flat rate local service to local measured service has been implemented slowly, often because of the opposition of consumer groups (Wenders, 1990). Consumers have often been suspicious, expecting that LMS would increase, not decrease, their phone bills. They regarded unlimited use as a right not to be tampered with.

By 1987, however, LMS was a common option in cities. Cain and MacDonald (1991), using 1987 data for their study, found that only nine of the 71 cities included did not have an LMS option. Where low-cost LMS has been offered as an unlimited option, it is not only the poor who have taken

advantage of it. Many households exceeding the target income level choose to subscribe at low LMS rates (Gillis, Jenkins & Leitzel, 1986).

Although the use of a two-part tariff for telephone use goes back at least to 1913 (Levin & Case, 1988), discussion by economists of the concept known as local measured service (LMS) stems from Mitchell (1978). In its simplest form, LMS involves a network access fee, to cover the non-traffic-sensitive (NTS) costs of the telephone system, and a variable fee based on usage to cover the traffic-sensitive (TS) costs. As with any accounting breakdown, these divisions are somewhat arbitrary, but they are frequently used by regulatory agencies in various calculations, and telephone industry executives and regulators alike find little disagreement over the division.

Mitchell goes through a detailed analysis of the possible economic effects and benefits of a conversion to a two-part tariff for residential customers. He concludes that a two-part tariff consisting of a basic fixed charge and a variable one reflecting use would increase social welfare. His model does not include business users, nor the possibility of tier pricing for off-peak use.

The model indicates that all callers will reduce the number of calls (see also Park, Mitchell, Wetzel, & Alleman, 1983). Those who make more calls than average would have an increase in rates over current flat-rate tariffs, while those whose volume is low would pay less than at present. The network would attract new subscribers whose means preclude them from subscribing at flat-rate levels.

Park et al. (1983) and Jensik (1982) use data from three Illinois communities before and after the implementation of LMS on an experimental basis. The empirical results verify much of Mitchell's earlier theoretical work, including the conclusion that low-usage households would benefit, while high-usage households would pay more. Across the board, usage tended to drop with the implementation of LMS. Demographic factors accounted for only 11 percent of variance in the Park et al. analysis.

Griffin and Mayor (1987) substantiate the intuitive conclusion that when offered a choice between LMS and flat rate service, heavy users will choose the flat rate unless it is priced very high. They further determine that LMS will fall far short of its potential contribution to increased welfare unless a high proportion of subscribers participate in it. Their conclusions are consistent with those of Train, McFadden, and Ben-Akiva (1987) who find a high degree of substitutability between various service options, making it easy for users to change options if another one appears more economical.

Griffin and Mayor estimate the potential welfare gain from LMS in the range of \$400 million to \$800 million, depending on the subsidy in effect from long distance to local service.

As cross-subsidies are eliminated, analysts agree that the average cost of local, residential service must rise. This is because local service has been heavily subsidized by interstate and intrastate long distance service. Although the FCC has moved to reduce the cross-subsidy from interstate service, state regulatory agencies have found it politically difficult to eliminate the cross-subsidies from intrastate long distance (Teske, 1990).

The precept behind LMS is to make prices reflect actual costs. The heart of the motivation is economic efficiency, not distributional equity. If fee schedules reflect costs, users will pay for the actual services they are using, with a minimum of burden or cross-subsidy. This will maximize consumer surplus and thus maximize welfare.

Levin and Case (1988) find other benefits from the implementation of LMS. It can help solve the regulatory problems created by customer-owned pay telephones, shared tenant services, extended area services, emergency 911 service and vacation rates. Levin and Case also see LMS, with its unbundling of access charges, as a response to the equity issue of universal service. Since the access fee is normally quite low in comparison to flat rates, more households can afford to have access to a telephone line. Beyond the access fee, the amount they pay for phone service is voluntary, varying with use. And while LMS does not make service available to all, it does make it easier to design and implement a politically acceptable subsidy plan and target precisely those found in need of aid.

Renshaw (1985) purports to show that instituting a two-part tariff, as is typical under LMS, will not achieve the goal of attracting and holding low-income households on the network. He suggests that, to take advantage of externalities, consideration be given to such alternatives as targeted subsidies, rebates to low-income households, or geographical price discrimination.

Levin and Case argue that LMS will become imperative as regulators and phone companies come to realize that competition cannot be prevented. This position is more extreme than most other analysts, who predict that LMS will be offered generally as an alternative to flat rates.

LMS plans may be designed in a variety of ways. Griffin and Mayor argue that optimal pricing (to achieve maximum welfare), should have the following characteristics (p. 482):

- (a) a flat-rate option sufficiently high so as to achieve maximum LMS participation;

- (b) peak usage fees set close to marginal costs;
- (c) shoulder usage fees [for periods between peak and least use] set just high enough to prevent the creation of new peaks during shoulder periods;
- (d) off-peak prices set at zero to eliminate measurement and billing expenses for this period;
- (e) access prices set residually, so as to satisfy the zero-profit constraint; and
- (f) second-line access charges set at marginal costs.

Under the plan instituted in the Chicago area, the variable fee is based solely on call frequency for calls within an eight-mile radius. The fee for calls outside the eight-mile radius but within the LATA is factored for frequency, distance, duration and time of day. The fixed access charge is based on telephone line density (Levin & Case, 1988). Under another suggested schedule, the variable fee would include a set-up component, and a per-minute component (Levin & Case, 1988).

Griffin and Mayor comment that the idea of setting price equal to zero for off-peak periods is going to be hard to gain regulatory approval for. Telephone companies will always seek to exploit a revenue source. Regulatory bodies will balk, because any revenue from off-peak use could be used to subsidize other services. However, they reason, the marginal cost of off-peak service is virtually nothing, after the cost of metering such service is eliminated, and thus the price should be zero as well.

Likewise, the level of pricing for "shoulder" periods, before and after peak periods, will be controversial for similar reasons. Shoulder service is commonly priced higher than would be necessary to prevent new peaks, and this overpricing substantially reduces welfare.

²⁹ Bypass may occur over any segment of the telephone system. AT&T, long the monopoly power in long distance, fought to prevent competitors, like MCI and Sprint, from being allowed to offer competitive long distance services. The Federal Communications Commission's MCI decision (MCI Telecommunications, 1969), was the turning point in that battle. Today, customers have their choice of long distance carriers, and AT&T and suppliers frequently reprice their services to meet the competition.

Bypass of the local telephone loop is a more recent development. Judge Greene, in the AT&T divestiture decision (MFJ, 1982), appears to have assumed that the structure of the local exchange company industry would not change substantially, and that LECs would retain their monopoly power. This is one reason that he banned the regional Bell holding companies, which own most of the LECs, from most nonregulated services, and thus from the temptation to cross-subsidize from regulated, monopoly services.

An early bypass strategy available to large customers was to construct private facilities to connect with the long distance carriers. Bolter, Duvall, Kelsey, and McConnaughey (1984) cite several studies conducted for telephone companies, all of which showed that a significant portion of large business customers were already bypassing local phone loops. The primary motivation for bypass was cost reduction. No estimates are given, however, on the amount of telephone traffic actually diverted to bypass facilities. Later studies cited in Bolter, McConnaughey, and Kelsey (1990) indicate that the amount of local traffic diverted to bypass was still very small. With regulatory prohibitions generally removed, the bypass strategy is available to other customers wherever the incremental cost of the facilities proves to be less than the charges of the LEC or other service provider.

A 1983 FCC report on bypass (reported in Bolter et al., 1984) found that microwave was then the most common form of local bypass. The report noted that four technologies—microwave, satellite, coaxial cable, and optical fiber—could be put together in various combinations to form systems capable of bypass.

Rohlfs and Gilbert (1990) observe that local bypass, by conventional means, involves a substantial equipment investment to establish the connection between the customer and the inter-LATA carrier. Thus it is more feasible for heavy users, who are likely to be larger customers. They predict rapid adoption of bypass systems for customers who find it economically advantageous.

³⁰ A fear, probably justified, is that bypass could drain off a great deal of the high volume business, leaving small public switched telephone network (PSTN) users with a greater burden of the costs as well as long distance access charges. The latter is cited by Dr. J. S. Kraemer (Bolter et al., 1984) as a particular problem. A repeatedly expressed fear is that long distance access charges to the LECs, replacing the former subsidy from long distance, will be shared by a shrinking subscriber base of small users who cannot use bypass links. If volume users reduce their use of local networks, economies of scale may no longer be effective and this may result in higher costs to other local users. To the extent

that access charges are merely replacing subsidies formerly generated from long distance, the result is a redirection of costs to the actual users.

³¹ See discussions of this point by Farrell (1996), Noam (1995), Noll (1989), and Berg (1993).

³² The definition of basic service changes over time (NTIA, 1988). It is not improbable that eventually, "basic" telephone service will include the ability to access Internet, databases, or other information resources. Although this may change supply and demand curves, it is not significant to the present discussion.

³³ See Noam (1995), Egan and Wildman (1994) and Smith (1989) for wide-ranging discussions of issues, many value-related, which should be included in the public interest agenda.

³⁴ This list was derived from several sources, including Drake (1995), Egan and Wildman (1994) and Noam (1994).

CHAPTER 3

METHODS

In this chapter, we will review the research questions to be addressed, construct a model of the local cellular telephone market, make behavioral predictions based on that model and underlying theory, and set forth the methodology to be used in attempting to answer the research questions.

As stated in Chapter 1, this study will address two questions:

- 1) To what degree has the duopoly local structure of the cellular telephone industry resulted in competition?
- 2) How well has the level of competition thus achieved met the public policy objectives of regulation?

Local Cellular Market Model

Based on theoretical considerations discussed in Chapter 2, we will design an economic model of the local cellular telephone market and attempt to predict the behavior which is likely to be demonstrated by the firms operating within such a model.

The basic vendor structure has been determined by the FCC to be a duopoly in each market. As earlier noted, each geographic market is self-contained and there is little overlap. The service is such that it had no close substitutes during the period studied, but it would not be considered a necessity for most users. Within a few years, there may be another technology available which would be a substitute for some customers. The product is basically homogeneous and the investment required of the customer is relatively small.

Potential customers are numerous, but some customers may be large enough to exercise substantial bargaining power in the market. Customers are unlikely to perceive a significant difference between vendors in terms of service technical quality. Some customers are likely to use the service heavily, while others may use it very little. Customers can be divided by use into business and nonbusiness users. Thus, their telephone usage may be either primarily intrinsic (personal) or instrumental (professional). This difference in motivation for use is likely to have an influence on willingness to pay and therefore elasticity of demand. Business (instrumental) customers are likely to exhibit less demand elasticity (price responsiveness). Conversely, those who use the phone mainly for social purposes may reflect highly elastic demand.

During the period of the accumulation of data for this study, the industry was in its early growth phase, so new customers are innovators and early adopters, according to diffusion of innovation typology. Because cellular is a new and diffusing technology in this period, demand curves are dynamic and unpredictable. Demand growth is heavily dependent on increasing awareness of the technology and its benefits. It is probable that the market demand curves are shifting rapidly to the right.

As with most telecommunications, capital costs for the firm are substantial, and incremental costs of providing service are relatively low. Because of the nature of the technology, production capacity is ample for all ready buyers in the early years. Until traffic in a cell approaches a practical limit, short run marginal costs are very low and rationing is unnecessary. Vendors cannot readily control production as a variable, so the price setting model cannot be the Cournot type. This means that a variation of the Bertrand model is probably the operative one, because the firms have the power to set price but not only limited ability to set output, in terms of the number and length of calls. Market leadership similar to the Stackelberg pattern is a possibility, but the leader can only set price, not output. In most markets, there is a difference of a few

months to two years between the startup dates of the competing firms, which may be enough for an incumbent firm to become comfortably established.

Since the service is part of a communication network, there are network externalities associated with the increasing subscriber base. However, because cellular systems are interconnected with large, established wireline networks, the effect and value of the externalities may be comparatively small. To some extent, cellular service may supplant wireline service, because customers will make some calls on the cellular phones that they would otherwise make from a fixed location. This practice would partially offset the network externality effect.

In most markets, one of the firms is an affiliate of the local wireline company, and in most cases, the wireline affiliate came on line first. Many of the non-wireline firms are owned by regional Bell wireline cellular vendors in other regions, or McCaw Cellular, the first major national cellular holding company.

Behavioral Expectations

The literature on competition in duopoly and oligopoly settings indicates that some degree of competition is to be expected. However, no time series empirical studies have come to light concerning firm behavior in duopolies which are comparable to local cellular markets. Ruiz (1994), using data from one point in time for 306 markets, did not find statistical support for hypotheses that regulation or multimarket interaction affected prices. Two different tests for the effect of capacity constraints produced contradictory results. Adams (1990) found no support for rivalry theory based hypotheses in the determination of competitive behavior in cellular markets. Therefore, neither theory nor experience gives much indication as to the intensity of competition which might be encountered.

Some comparisons might be attempted with commercial air passenger routes between pairs of secondary cities, which are often served by a small number of carriers.

Short haul, low competition routes tend to have higher fares, relative to distance, than denser, more competitive routes, and lower fares than monopoly routes (Shepherd, 1990). However, these conclusions are confounded by related factors, since many short-haul routes connect with major routes at hub airports, they involve terminal costs comparable to longer flights, and airfare structures are exceedingly complex and subject to abrupt changes.

Duopoly prices can be expected to be lower than monopoly prices, but higher than those under a regime of perfect competition. If one vendor is able to gain a substantial advantage in market power, possibly through early entry, that firm may be in a position to exercise price leadership. Given that the first entrant usually had only a few months head start in a cellular market, this seems an unlikely scenario.

Even if there is tacit collusion to maintain prices, there is likely to be competition in the forms of product differentiation and service quality, and attempts by the firms to segment their markets to practice price discrimination. As is usually the case with communication networks, a two-part fee pattern is probable, consisting of a fixed access fee and a variable fee dependent on usage. Marked cyclical variation in demand may also encourage peak load pricing. Cross-subsidies are unlikely, except between customer groups with differing elasticities of demand.

Consumer surplus should be greater under duopoly conditions than under a monopoly regime. However, with only two firms in each market, the vendors know that they are not in a perfectly competitive situation and that therefore each can exercise influence on prices.

Data Set

An extensive data set is available covering the seven-year period from 1985 to 1991, the period when the industry achieved complete coverage of the first 30 markets

with service by two providers (Information Enterprises, 1991). By September 1987, all top 30 markets were served by two cellular vendors.

The data set consists of retail and wholesale data obtained in January of each year on the following: Service packages offered including full details; extra features offered and their prices; relevant service details, such as peak/off-peak hours and billing time increments; date of entry of each firm into the market. By the beginning of 1985, the wireline service provider was in operation in all but four of the 30 markets, and nine of these markets had non-wireline providers as well. By August 1985, all 30 markets had service provided by the wireline company. Non-wireline providers had begun service in 14 of the 30 markets by January 1986, and in 26 of the 30 by January 1987. The last top 30 market to get a non-wireline provider on line was Tampa on September 25, 1987.

Our primary interest, in the analysis of this data set, is in comparing and analyzing price behavior as a reflection of competition between operators within each market. Although the data may be profitably used for many other purposes, the emphasis of this study is on performance within the duopoly market structure.

The industry is characterized by a multitude of pricing plans, as operators attempt to gain a competitive advantage, segment their markets, and practice price discrimination. Different combinations of fixed and variable pricing are used in different service packages. In later years, many vendors increased the number of packages offered and optional features. Thus, making price comparisons has its pitfalls.

The unique seven-year data set was compiled by Information Enterprises of Bland, Mo. and is used with the permission of that firm. Information Enterprises is no longer engaged in gathering such data and providing this service.

The data set has three important limitations for the purposes of this analysis:

1. Data are absent on the number of subscribers in each market and the market share of competing firms. Although national data are compiled and reported on the number of cellular subscribers, comparable information on the local level is proprietary and thus confidential. If pricing strategies could be related to total penetration and market share, the results might be even more illuminating.

2. Vendors' cost information is not available. Except possibly in some states (a decreasing number) where cellular prices are regulated, cost data are not made public. All wireline operations, and an increasing number of non-wireline operations, are owned by firms not engaged solely or even primarily in cellular telephone. We cannot look to the profitability of the parent firms for an indication of cellular system profitability, except to the limited extent that publicly held firms choose to reveal such information. Comprehensive data are not available on profitability, either locally or nationally.

3. The price data are available only on an annual basis. We cannot track short term price swings, special promotions, and other price-related strategies which might reveal evidence of competition or the lack of it.

Procedures

This analysis is concerned primarily with competition within each cellular market, based on performance in the first 30 markets established under FCC policies in the mid-eighties. Therefore, the study will endeavor to examine and compare performance characteristics within each market, in some cases using composite data from all markets to establish baselines for comparison purposes. The 30 markets have been collapsed to 28, because in two cases, geographically adjoining markets had the same participating firms and identical pricing and packaging patterns.

The available data set enables analysis of four of the seven competitive price behaviors discussed in Chapter 1. Data which quantify each of the four behaviors are

used to construct indices reflecting the degrees of behavior. The behaviors are operationalized and the indices constructed as follows:

Three different pricing packages are computed to determine the optimal per-minute price for three customer profiles for each firm for each year. The representative customer profiles are defined and typified as follows: Small, occasional customers, using less than 50 minutes per month; medium-use customers, using 200 minutes per month; large customers, using 500 minutes per month. Although some customers use far more than 500 minutes per month, in most markets and at most points in time the package which best serves the 500-minute customer would best serve larger customers as well.

This study does not attempt to model actual customer behavior. Weighting the groups according to usage is not attempted and is not necessary for present purposes. The comparisons will be used to evaluate the intensity of competitive behavior of the two firms involved in each market, as reflected in pricing behaviors intended to capture market share and boost profits.

A spreadsheet is developed, starting with the per-minute variable cost for the best package for each user profile at each point in time for each firm. A review of the data shows that manipulation of the per-minute price is the commonly used competitive pricing device, not manipulation of the access fee. In many cases access fees are identical or similar for comparable packages, and except for the smallest user groups, the access fee constitutes a small portion of the total monthly cost. Beginning data also include the number of retail price plans for each firm and the number of special features offered by each firm, both those given free and those for which a charge is made. These beginning data, extracted from the original data set, are shown in Appendix A. All computations in succeeding appendices are derived from these data.

Four indices are constructed, using the foregoing price and service data, designed to quantify four forms of competitive behavior, and the results are presented.

Methodology on the construction of each index is given in the following section of this chapter. Appendices B through E present the four indices by market and firm.

Appendix F summarizes the index data.

Appendices G and H present the markets and firms rank ordered according to the four indices to generate ordinal data from the indices. Because the indices are not comparable to one another, this is the best means to gain some degree of comparability between indices. Finally, cross-correlation results between pairs of the four market rank order lists are presented in Appendix I.

Index Construction

The four indices are constructed as follows:

General price level changes: Changes in prices levels for each user class are tracked and compared with the change in the Consumer Price Index (CPI) for each annual period. The difference between the price level change, expressed as a percentage, and the CPI change percentage is computed, multiplied by 100 and the sign reversed. The resulting figure for each user of the three classes is called the Price Performance Index (PPI). In addition, the mean of the three PPIs for each firm for each year is computed to determine the firm's PPI for each year. This composite PPI is labeled the PPI-M.

Price disparities: The difference between prices of competing firms in a market can be a strong indicator of the degree of competition. Using the previously computed price levels for each of the representative user groups, the difference in prices is computed for each user class in each market at each annual point. The percentage difference in the per-minute price (based on the lower price) is computed and multiplied by 100. This figure is labeled the Price Difference Index or PDI. Unlike the PPI, the PDI represents a measure of competition between the firms, not each firm's individual competitive behavior. So if each firm cuts prices substantially, but they end up with the

same price, the PDI will be zero, while the PPI may be substantial. Thus the PDI reflects certain types of competitive behavior, but not others.

Multiple pricing: The total number of retail pricing packages is computed for each market by adding the number of retail packages offered by each firm. Wholesale packages, designed to be marked up and offered through resellers, are not included because they obscure the duopolistic nature of the markets. It has been common in the cellular business for operators to use resellers to augment their own retail sales forces, and wholesale packages represent the operators' attempts to offer inducements to reselling firms. It would be exceedingly difficult, even if reseller pricing information were available, to integrate it meaningfully into this analysis. The total number of retail packages offered indicates firms' efforts to segment their markets and appeal to various groups within the potential customer base. In most cases, the firms allow their customers to self-select their group by selecting a particular plan. The only evidence of selection by fiat of the firm is in a small number of markets where government agencies are offered special plans, generally lower in cost, which are unavailable to the general public. The total number of retail pricing plans in each market is determined to yield the Segmentation Index (SI) for the market.

Product differentiation: In an essentially standardized service like cellular telephone, which must be operated strictly within the technical standards set by the FCC, it is difficult to differentiate the product from that of competitors. Nonetheless, the industry gradually developed a menu of special services and enhancements, most of which are technological in nature, or made possible by the use of technology. These include such features as special billings, call waiting, call forwarding, etc. Often these services and features involve an extra monthly charge, although the charge is usually quite small. Many system operators simply added in some of the new features at no extra charge. Because a free feature is more of an inducement to customers than a feature for which a charge is levied, free features are weighted more heavily in the

index. The total number of free features and features for which a charge is made is determined in each market. The total of the features which are charged for is divided by two to reduce their weighting, then added to the number of free features, and the total divided by two to compute the Service Differentiation Index (SDI) for each market.

Evaluation of Economic Results

In the absence of cost data, which would show how effectively competition is driving price (P) toward marginal cost (MC), no one index or indicator can be expected to fully reflect the degree of competition within a market. The best we can do is to use a variety of indicators, each of which can measure a type of behavior deemed to be competitive in nature. None of the indices presented can be adopted as the single indicator which most accurately reflects competitive conditions. By constructing all of these indicators, and evaluating each, we may arrive at a broad picture of competitive conditions.

A market-by-market analysis is conducted to determine what inferences may be drawn from the numerical results at the market level. Each market is rated in terms of the degree of competitive behavior exhibited, on the following scale: Low competition, moderate competition, high competition. As results warrant, generalized conclusions may be drawn.

Analysis is made of the rank order lists and correlations to determine possible relationships between the rank orders and therefore between the indices.

Finally, generalized results of the market analyses and tests will be compared with the model and predicted behavior patterns set forth at the beginning of this chapter, to test how well the theoretical expectations are borne out by the results of observed behavior.

It must be emphasized that the four indices are limited in their comparability with one another and for purposes of evaluating cellular telephone duopoly against other duopoly situations. The four indices are independent of one another as far as quantification is concerned, so they cannot be compared as cardinal numbers. Therefore, we will not attempt to compute a composite index using the four performance indices.

Although it would be desirable to be able to compare competition exhibited in the cellular telephone industry with competition as it may exist in other industries, these particular indices, as constructed, may not be so applicable. It should be possible to operationalize the concepts and construct indices comparable to the PPI and PDI for other industries for other industries, but the author has found none for other duopolies. The operationalization of concepts for the SI and SDI, however, are so peculiar to cellular telephone as to nearly preclude the possibility of comparison with other industries.

Public Policy Assessment

Although economists widely agree that competition is generally desirable, it is not an end in itself. Rather, it is a condition which may bring about other socially desirable results, most especially lower prices. And while lower prices are certainly welcomed, in order to increase consumer surplus and widen the availability of services, public policy may pursue other goals as well.

At the end of Chapter 2, nine policy objectives were specified which could be considered applicable to cellular telephone. Conceivably, all of these could be cast in economic terms; some are clearly primarily economic in nature. From the available data and our analysis of it, we will discuss and evaluate the apparent impact of duopoly structure on the following six:

- 1) Universal service (in terms of equal and affordable access)

- 2) High quality of service
- 3) Encouragement of improvement, innovation and evolution
- 4) Prevention of oligopolistic behavior by integrators and carriers
- 5) Rate regulation of carriers with market power
- 6) Participatory fairness in access to new services

More specifically, the following questions and issues will be analyzed:

- 1) Is the duopoly structure of the local cellular telephone market likely to increase access to telephone systems to consumers who cannot presently get such access? Can public policy formulators take advantage of cellular market conditions to extend accessibility and pursue the ideal of universal service?
- 2) Does duopoly structure encourage high quality service?
- 3) Does duopoly structure serve to encourage innovation and development of the telephone system?
- 4) Can oligopolistic behavior which is counter to consumer interest be prevented or minimized within a duopolistic environment? Is the observed performance an improvement over the performance of regulated monopolies in the telephone industry?
- 5) Is rate regulation justified or desirable?
- 6) Will the various segments of society receive fair treatment in reference to access to the technology under a duopoly market regime?

In brief, then, the analytical procedure is this: Four indices are constructed which are designed to reflect and quantify four types of competitive behavior. Data from 28 cellular markets are entered and the indices computed for each market. The results are reviewed for each market and evaluated to determine degree of competition. Because of the idiosyncratic nature of the markets, a short narrative interprets the results in each market. Industry behavior is also compared to behavior expected under the

theory-based model. Overall conclusions are drawn concerning the effectiveness of duopoly market structure in fostering competition.

In view of the economic analysis, the six public policy objectives deemed relevant to the cellular telephone industry are reviewed. Determination is made as to how well these objectives appear to be served by the economic performance of the cellular industry local structure.

CHAPTER 4

RESULTS AND ANALYSIS

The numerical results of the analytical procedures set forth in Chapter 3 are shown in the tables in Appendices B-I at the end of this volume. The tables, which correspond to the Chapter 3 procedures, should be self-explanatory. In this chapter, we will interpret the findings market by market, then discuss overall findings, particularly in terms of the market model and predicted behavior. The chapter ends with a review of public policy objectives and possible ramifications of the findings on public policy.

Included with the commentary on each market is a tabulation of the means for the four indices. The Price Performance Index (PPI) is given for each firm (PPI-1 and PPI-2) as well as the market mean (PPI-M). Also shown for each market are the Price Difference Index (PDI), Service Differentiation Index (SDI) and Segmentation Index (SI). Complete index results period by period are given in Appendices B through E. The all-market means of the indices are given below for purposes of comparison.

<u>Indices--means of all markets</u>	PPI-M	4.34	PDI	8.86
(for baseline comparison purposes)	SDI	5.21	SI	7.97

Market-by-Market Findings

<u>Atlanta</u>	PPI-1	6.40	PPI-2	4.77	PPI-M	5.58
Competitive rating: Low	PDI	0	SDI	5.57	SI	7.14

Except for some sharp price reductions in the first year of operation of the wireline firm, prices were unchanged in the Atlanta market for the period studied. The

wireline firm had no competition until the fourth year of the period, and the entry of the competitor caused no fluctuations in any of the three price indicators. The fact that prices were absolutely stable after the first year, however, meant that the price performance index for each firm was positive by the amount of the increase in the CPI.

Because the two competing firms maintained identical price schedules, the price difference index remained at zero, an indicator of a lack of competition. The two other indicators of competition told a different story. Just prior to the entry of the non-wireline firm in February 1987, the service differentiation index increased to 5.5, higher than the national mean of 4.97 at that time. By January 1988, the SDI had increased to 7.5, and it inched up to 7.75 by 1990. During the same period, the national SDI mean rose to 6.30, then slowly to 6.66 by 1991. The segmentation index was consistently higher than the national mean starting in January 1989. At that time, the SI in Atlanta was 11, compared to the national mean of 9.29, and it rose to 12 in 1991.

<u>Baltimore-Washington</u>	PPI-1	1.40	PPI-2	5.78	PPI-M	3.59
Competitive rating: High	PDI	10.72	SDI	7.32	SI	12.43

Baltimore-Washington, the first market to have a duopoly situation, is an interesting market to watch. Price fluctuations were not frequent in this market, but in the small and medium user categories, substantial price differences were the norm. The non-wireline operator adjusted prices more often than the wireline firm. Baltimore-Washington is also one of the unusual markets where the non-wireline firm began service first.

The non-wireline firm opened 1985 with higher prices across the board. The wireline firm enjoyed a mean price difference index advantage of 20 for the three levels of service. By 1986, however, the non-wireline firm had dropped its prices in two of the three categories of service, and the wireline firm had raised its prices for the smallest users to a higher level than its competitor. In year-to-year comparisons,

measured by the price performance index, both firms fluctuated widely, but neither one increased prices in any one year on average as much as the increase in the CPI. For the six periods, the wireline firm scored a composite 1.40 on the PPI, while the non-wireline firm's composite PPI was 5.78.

The segmentation index and service differentiation index indicate a higher-than-average level of competition. The SI consistently was much higher than the national mean until the final year, when it dropped to nine. The SDI began at 5.25, more than twice the national mean, and rose steadily to 8.25 in 1991, always above the national mean.

<u>Boston</u>	PPI-1	3.04	PPI-2	7.63	PPI-M	5.34
Competitive rating: Moderate	PDI	9.75	SDI	4.43	SI	8.71

Price performance and price differences in the Boston market indicate serious competition for the small and medium-sized customers but steady prices and uniformity for large ones. The wireline firm maintained steady prices from 1985 to 1990, adjusting them only in the final year. Those adjustments were mixed however--price increases for two groups of customers and a reduction for one. The non-wireline firm, however, adjusted prices oftener--always downward. Thus the composite PPI of the wireline firm was 3.04, while the non-wireline firm earned a PPI of 7.63--fifth highest among the 56 firms studied. Price disparities were the rule, not the exception, in the Boston market. As a result, the mean PDI for the market over the seven periods was 9.75.

By the segmentation and service differentiation indices, Boston was not a particularly competitive market. The SI varied from 7 to 10, starting out higher than the national average but slipping below that average by 1988. The Boston SDI was below the national mean in all periods except one, when it was marginally higher.

<u>Buffalo</u>	PPI-1	3.67	PPI-2	1.29	PPI-M	2.48
Competitive rating: Moderate	PDI	10.46	SDI	4.54	SI	11.43

The Buffalo market is something of an anomaly, because prices there started out lower than most markets and lagged throughout the period. These consistent low prices, with several moderate increases, kept the price performance index relatively low for the six periods. Other indicators tell a different story, however. In many of the periods, in all three classes, significant differences in price were maintained. The PDI for small customers averaged 19 for the seven years, third highest in the 28 markets. The composite PDI-M for the three classes over seven years was 10.46, well above the 28-market mean.

In segmentation, Buffalo consistently was well above the 28-market average, starting at 7 in 1985 and increasing steadily to 15 in 1991. In service differentiation, however, the Buffalo market lagged, running below the 28-market mean in every period. Buffalo firms simply offered fewer enhancements, both free and paid, than firms in most other markets.

<u>Chicago</u>	PPI-1	8.90	PPI-2	4.30	PPI-M	6.60
Competitive rating: High	PDI	15.32	SDI	5.64	SI	11.29

In price competition, the Chicago cellular firms followed the tradition of heavy competition set decades ago by the mass media of the Windy City. Both firms were operational by January 1985, with the non-wireline firm setting its prices significantly below those of the wireline firm. Through most of the period, the non-wireline firm either held its lower prices or matched the price cuts of its wireline competitor. The wireline firm did a lot more adjusting of prices, especially downward. As a result, the wireline firm earned a composite PPI for the period of 8.90, while the non-wireline firm, with generally lower prices, had a composite PPI of 4.30.

The generally lower prices of the non-wireline firm gave the market a composite price difference index of 15.32 for the seven periods, the fifth highest among the 28 markets. Chicago was also consistently well above the mean on the segmentation index, ending the seven years with a score of 16, one of the highest in the country. On the service differentiation index, Chicago was usually higher than the mean, but not by a great margin.

<u>Cincinnati</u>	PPI-1	2.24	PPI-2	1.29	PPI-M	1.76
Competitive rating: Low	PDI	2.54	SDI	5.71	SI	9.33

Prices in Cincinnati tended to be stable, with small or nonexistent differences between the competing firms. Both firms made price adjustments in the period ending January 1990. Although they reduced prices slightly for the middle size users, the overall effect was higher prices, and negative price performance indicators for that period. This in part offset the effect of generally stable prices and low positive PPIs in other periods.

The price difference index tells a similar story. For most classes of customers in most periods, there was no more than a small difference between the competing firms and consequent small PDIs. The firms listed identical prices for mid-sized users throughout the five years for which we have complete data, and price differences were usually no more than five cents per minute for other classes. The composite PDI for all classes and all periods was only 2.54, well below the 28-market mean of 8.86.

In segmentation and differentiation strategies, the indicators were somewhat more robust. Cincinnati firms were above the 28-market mean on the SI for most periods, rising sharply in 1990 and 1991. On the service differentiation index, Cincinnati was close to the mean at all reporting dates.

<u>Cleveland</u>	PPI-1	6.32	PPI-2	3.93	PPI-M	5.12
Competitive rating: Moderate	PDI	4.78	SDI	4.79	SI	5.14

Cincinnati and Cleveland represent the only pair of markets in this entire study where the same two parent firms are competing head-to-head through local subsidiaries. As such, it is interesting to compare performance in these two markets.

The wireline firm got the earlier start in Cleveland, and its prices were reduced sharply after the entry of the competing non-wireline firm. This had a favorable effect on the wireline firm's PPI, which had a mean of 6.32 for all prices classes and periods. Both firms adjusted prices again in the period ending January 1990, leading to an overall lower level of prices. The wireline firm tended to be the more aggressive of the two, usually listing lower prices where there was a difference. However, as was the case in Cincinnati, the price differences tended to be relatively small, resulting in small price difference index numbers. For the entire period, the PDI was 4.78, higher than in Cincinnati but well below the 28-market mean.

Similar patterns hold for the SI and SDI. The Cleveland SI was below the 28-market mean at every reporting date, and the SDI tended to be close to the 28-market mean, but below it more often than above.

<u>Dallas</u>	PPI-1	2.36	PPI-2	6.88	PPI-M	4.62
Competitive rating: Low	PDI	2.31	SDI	4.46	SI	6.00

In Dallas, the wireline firm had an entry lead time of more than 19 months over its non-wireline rival, which merely matched the established firm's prices when it entered the market. Prices were stable for two years, then both firms cut prices to medium and large users during the period ending January 1989. The wireline firm maintained level prices after that, while the non-wireline firm made some price adjustments in 1990 and 1991, most notably a substantial price reduction for small users in 1991.

The overall result was relatively low numbers on the price performance index and price difference index. The mean PPI for the wireline firm was 2.36, compared to 6.88 for the non-wireline firm. The wireline firm's PPI was negatively impacted in 1987, when it raised the price to small users from an unusually low 38 cents per minute to 60 cents, a level comparable to prices for this class in many other markets. It maintained this price for the rest of the period of study, resulting in small positive PPI numbers.

Because the firms had identical prices or relatively small price differences for most classes and period, the PDI was usually low, as well. The PDI was 2.31 for the entire period.

Other indicators show only moderate competition. The SI generally as below the 28-market mean, exceeding it slightly in 1990 and 1991. The SDI tended to be slightly below the 28-market mean.

<u>Denver</u>	PPI-1	4.11	PPI-2	6.08	PPI-M	5.09
Competitive rating: High	PDI	12.94	SDI	6.36	SI	7.57

The Denver market shows an interesting pattern of a wireline firm getting an early entry advantage and following generally stable pricing policies, and a non-wireline firm using more aggressive tactics to win customers, especially among larger users. The wireline firm had a head start of more than two years.

The wireline firm mean PPI of 4.11 reflects this price stability with a slight downward trend, while the non-wireline firm earned a 6.08 PPI for the period it was in the market. This is substantially above the 56-firm mean PPI, but not among the most aggressive firms in the study. Differences were substantial, however, especially in the last two reporting periods. Therefore, the PDI for the market was 12.94, ranking Denver as one of the more competitive markets by this scale. At the last three

reporting dates, the PDI was 15.85, 18.40 and 19.05, respectively, reflecting widening gaps between the prices for comparable services.

Competitive behavior as reflected in segmentation and differentiation strategies was mixed. The Denver segmentation index peaked at 11 in 1987 and 1988, then declined and remained below the 28-market mean for the rest of the study period. The service differentiation index was consistently above the 28-market mean. However, it peaked at 8.25 in 1988 and 1989, then declined to 7.5 when the non-wire firm began charging for some services which had previously been included free of charge. The wireline firm, while maintaining higher charges for medium and large users, threw in more free features.

<u>Detroit</u>	PPI-1	6.00	PPI-2	2.56	PPI-M	4.28
Competitive rating: Moderate	PDI	15.12	SDI	5.64	SI	9.71

Price adjustments were more frequent in the Detroit markets than many others, but they were not always reductions. Indeed, the story in Detroit seems to be one of attempts to increase profit margins as much as it tells of competitive price-cutting.

With price increases nearly as common as reductions, the two Detroit firms do not appear very competitive by the price performance index. The wireline firm earned a composite PPI of 6.00, but this was influenced by a large reduction in one class of service shortly after the competitor entered the market. The non-wireline firm earned a composite PPI of only 2.56.

Unlike many markets, Detroit had very few periods when the competing firms charged the same rates for comparable service. First one firm would be lower, then the other, varying with the class of service and the period. Thus, the price difference index was usually high. The mean PDI for the three classes of service ranged from a low of 5.13 to a high of 24.15, with a PDI composite of 15.12, the sixth highest among the 28 studied.

Gauged by the SI and SDI, the Detroit market was more competitive than most, also. Detroit's segmentation index was above the 28-market mean in all years except two, and the service differentiation index was consistently above the 28-market mean after 1986. Detroit's SI hit a high of 17 in 1991, the second highest for any market in any period.

<u>Houston</u>	PPI-1	7.23	PPI-2	4.48	PPI-M	5.85
Competitive rating: Moderate	PDI	16.70	SDI	4.46	SI	6.43

Houston firms followed the practice of maintaining price levels except in the period ending January 1988, when the wireline firm reduced its prices across the board. The non-wireline firm, which had set its prices upon entry close to those of the wireline firm, did not follow. As a result, a price difference of about 20 percent was created which remained for the rest of the study period.

The disparity in these practices is reflected in the indices. The composite PPIs for Houston firms were nothing spectacular: 7.23 for the wireline firm, and only 4.48 for the non-wireline. However, the PDI was 20.67 for the years 1988-91, and 16.7 for the five years the two firms competed.

The SI and SDI indicators also reflect a limited desire to compete. The SI was consistently below the 28-market mean, and remained flat at 9 for the last four years of the study, although the 28-market mean continued to rise. The SDI remained close to or below the 28-market mean. It also stayed flat at 5 for the final four years, while the 28-market mean edged up annually.

<u>Indianapolis</u>	PPI-1	6.48	PPI-2	9.23	PPI-M	7.85
Competitive rating: High	PDI	12.18	SDI	3.46	SI	9.86

Price reductions were quite commonplace in the Indianapolis market, usually initiated by the non-wireline firm. As a result, Indianapolis ended the seven-year study period with some of the lowest prices in the country, at all levels of service.

The wireline firm tended to keep its prices steady, except in the period ending January 1988, when it made substantial price reductions in all three levels of service. It earned a composite PPI of 6.48. The non-wireline firm, on the other hand, made much more frequent price changes, usually downward, earning a PPI of 9.23.

In most periods, there were differences between the firms' prices. Overall, the PDI was 12.18 for the seven-year period.

The Indianapolis firms started out in 1985 with an unusually high number of retail plans. For six years straight, the market earned an SI rating of 10, dropping to 9 in 1991. Competition was less pronounced in providing service enhancements, however. The market was consistently one of the lowest on the SDI.

<u>Kansas City</u>	PPI-1	1.60	PPI-2	6.30	PPI-M	3.95
Competitive rating: Moderate	PDI	8.67	SDI	3.61	SI	8.29

Price competition was limited in Kansas City, because the wireline firm was not very prone to price cutting. The firm cut prices moderately for two classes of service in 1990, then raised them sharply in 1991. The non-wireline firm matched its competitor's prices for small users, and held prices somewhat lower for medium and large users in most periods. As a result, the wireline firm had composite PPI of 1.60, ninth lowest among the 56 firms surveyed, while the non-wireline firm earned a 6.30 PPI.

The consistent price differences for two classes of users earned the market a PDI of 8.67, below the 28-market mean of 9.14. Even this figure was exaggerated by the wireline firm's substantial price increase in the final period, which was not matched by the non-wireline competitor.

The segmentation index for Kansas City followed the national trend, rising gradually to 16 in 1990, then dropping to 11 in 1991. In four of the seven periods it was below the 28-market mean. Kansas City's SDI was consistently below the 28-market mean except in the initial year. It flattened out at 4.25 for the last four years and was the lowest in the study in 1990 and 1991.

<u>Los Angeles</u>	PPI-1	-2.21	PPI-2	4.77	PPI-M	1.28
Competitive rating: Low	PDI	2.27	SDI	4.79	SI	11.43

Competition was slow in coming to the giant Los Angeles market, and after the initial period, the wireline company did little except hold the line on its higher-than-average prices. When the non-wireline firm appeared in 1987, it matched the prices of its established competitor. The wireline firm responded by raising prices to the smallest users in the following year. The indices based on price behavior give little evidence of competition. The Los Angeles wireline firm shows a composite PPI of -2.21, one of only four firms in the entire study to earn a negative rating. The non-wireline firm had a composite PPI of 4.77. On the PDI, the Los Angeles market scored 2.27, sixth lowest among the 28 markets.

Only on the segmentation index did the Los Angeles market show any indication of serious competition. LA was consistently far above the 28-market mean after 1985, and ended the study period with an SI of 18--highest among the 28 markets. On the SDI, Los Angeles tended to be slightly below the 28-market mean.

<u>Miami</u>	PPI-1	5.72	PPI-2	2.52	PPI-M	4.12
Competitive rating: High	PDI	17.41	SDI	3.25	SI	7.57

Miami service providers adjusted their prices quite frequently, often to the benefit of customers. The wireline firm had a head start of nearly three years, and it reduced prices several times during this period. By the time the non-wireline firm

entered, the wireline firm had stabilized prices, and they trended upward from 1988 on. Largely on the strength of early price cuts, the wireline firm earned a composite PPI of 5.7. The non-wireline firm scored 2.52 for the three periods it was in the market.

The price difference index tells a more competitive story. Each firm had its turn at being the low price leader, and they rarely quoted the same prices for comparable service. As a result, the PDI-M was 17.41 for the four years they competed--second highest in the 28 markets.

The number of retail plans offered changed more frequently than prices. The Miami market hit a high of 14 on the SI in 1988--the second highest in the country at that time. However, the SDI fell to 8 in 1990, then rose to 12 in 1991 as the firms jockeyed for position. On the SDI, the Miami market consistently lagged most other markets, never getting over 4.75.

<u>Milwaukee</u>	PPI-1	4.65	PPI-2	4.52	PPI-M	4.58
Competitive rating: High	PDI	23.55	SDI	4.61	SI	8.43

Prices and the indices reveal an unusual pattern in the Milwaukee market, where two firms were in competition from the start of the period of this study. The wireline firm started with higher prices, and brought many of them gradually downward toward those of the non-wireline firm, which entered the market with a lower price structure and never varied. As a result, the prices in the Milwaukee market were some of the lowest in the 28 markets by 1991.

The PPI in such a situation of relative stability does not indicate strong competition. The wireline company's composite PPI was 4.65, while the non-wireline firm's was 4.52. On the PDI, however, the recurring competitive difference is clearly indicated. For the entire period, the market's mean PDI was 23.55, the highest in the study. This is despite the fact that the non-wireline firm forced its competitor to match

its low price of 22 cents per minute for both medium and large users during the last three years of the period.

On the segmentation index, the Milwaukee market was above the 28-market mean for the years 1985-87, and consistently close to the mean for the next four years. On the SDI, the market was generally below the 28-market mean, but not by a wide margin.

<u>Minneapolis</u>	PPI-1	6.47	PPI-2	4.35	PPI-M	5.41
Competitive rating: High	PDI	10.84	SDI	6.71	SI	8.14

Firms in the Minneapolis market were more active than in most others in making price adjustments, resulting in higher than average scores on the PPI and PDI.

Competition existed from the beginning of the study period, and the wireline firm aggressively adjusted prices. This firm had a composite price performance index rating of 6.47, indicating a tendency to reduce prices. The firm reduced prices six times and raised them twice. The amounts of the price reductions tended to be moderate, however. The non-wireline firm cut prices five times and raised them four times, earning a PPI of 4.35, slightly above the 56-firm mean. Price-cutting was especially prevalent during the last two years of the period under study.

These price manipulations produced differences between price levels in most periods and user classes. The wireline firm was usually--but not always--the lower priced firm. For the entire study, the mean price differentiation index for the Minneapolis market was 10.84.

In terms of both segmentation and service differentiation, the Minneapolis market tended to be above the 28-market means. In four out of seven periods, the Minneapolis SI was higher than the 28-market mean, although in the later years of the study it was close to that figure. In every period the Minneapolis SDI index was well above the 28-market mean, ending at 8.75 in 1991, second highest among all markets.

<u>New Orleans</u>	PPI-1	6.36	PPI-2	4.18	PPI-M	5.27
Competitive rating: Moderate	PDI	4.51	SDI	4.93	SI	5.29

The New Orleans market shows how the use of a single index to monitor competition could produce very misleading results.

Generally speaking, prices were stable in New Orleans, and the price differences were small--never more than 2 cents per minute. However, in the year before the non-wireline firm entered the market, the wireline firm cut prices across the board, earning it a PPI rating of 16.28 for that year. During the rest of the period, it held prices firm, with only one comparatively small price reduction. As a result, it earned a composite PPI of 6.36--well above the 56-firm mean. The non-wireline firm also held its prices quite stable--1 to 2 cents below the competition, and cut its price in the year ended January 1990, only to meet the wireline firm's reduction in the previous year.

The price difference index tells the more accurate story. The non-wireline firm held prices for small and medium sized firms below the wireline firm in every period. The same was true for the largest users until the wireline firm cut its prices and was matched by the non-wireline firm. Only in the final two years of the study, in one class, did the firms have identical prices. Interestingly, there were no price increases by either firm in this market.

The competitive spirit did not extend to segmentation. New Orleans usually was below the 28-market mean on the SI, although the number of retail plans offered doubled from 5 to 10 between 1989 and 1990. This was the same period when the price-cutting occurred. The market tended to be close to the 28-market mean on the SDI index, running below it the last three years of the study.

<u>New York</u>	PPI-1	5.61	PPI-2	3.92	PPI-M	4.76
Competitive rating: Moderate	PDI	10.34	SDI	5.68	SI	6.29

An entrenched wireline firm facing a low-priced newcomer is the story of the big New York market, with predictable results. The wireline firm was in operation nearly for two years before the non-wireline firm entered in 1986. Upon entry, the wireline firm reduced midrange prices, but held its rates for the smallest and largest customers. The challenging firm set prices below the established firm, except for the largest customers, but raised a price once, while the wireline firm made two cuts. As a result, the wireline firm earned a PPI of 5.61, while the generally lower non-wireline firm's PPI was 3.92.

The PDI told a different story, however. Because of the continuing gap between the firms' prices in the low and medium ranges, the market had a mean PDI of 10.34 for the five years of competition. It appears that the non-wireline firm was seriously attempting to compete on price, but the wireline firm felt it could afford to hold most prices higher.

In service differentiation, New York was consistently above the 28-market mean after the entry of the non-wireline firm, but not by a wide margin. For the seven years, the New York market mean SDI was 5.68, compared to the 28-market mean of 5.11. On the segmentation index, New York peaked at 9 in January 1987, dropping back to 6 for the rest of the period for a mean of 6.29, well below the 28-market mean of 7.97.

<u>Philadelphia</u>	PPI-1	0.58	PPI-2	3.32	PPI-M	1.95
Competitive rating: Low	PDI	1.50	SDI	6.57	SI	8.29

Price matching and stability was the story in the Philadelphia market, where the wireline firm had a 19-month head start to gain position. The non-wireline firm entered the market with prices at or slightly above the established firm, and the wireline firm raised prices in one class to match the higher competitor. The firms offered identical prices for the three classes of service for the next three years. In 1991, both

firms raised prices to small users and the wireline firm cut its price to large users by 11 percent.

These patterns earned the Philadelphia market low numbers for the two price-related indices. On the PPI, the wireline firm had a composite 0.58, and the non-wireline firm 3.32--both well below the 56-firm mean. The Philadelphia mean PDI was a meager 1.50.

Nor was competition particularly robust in terms of segmentation or service differentiation. Philly generally was close to or slightly below the 28-market mean on the SI, and somewhat above the 25-market mean on the SDI. However, it ended the period with an SI of 16 as retail price plans burgeoned in 1991. The Philadelphia SDI rating was 7.5 in 1990 and 1991--fairly high but not extraordinary.

<u>Phoenix</u>	PPI-1	3.39	PPI-2	6.29	PPI-M	4.84
Competitive rating: Moderate	PDI	8.95	SDI	6.64	SI	6.57

Phoenix prices were generally stable until the period ending January 1990, when substantial price-cutting took place, followed by increases the following year. The wireline firm enjoyed a 19-month lead on the competition. When the non-wireline firm entered, it set prices slightly below the competition in all three classes. A year later, it raised prices for the largest users to the level of the wireline firm, and both firms held their prices steady for the next two years. In the period ending January 1990, both firms cut their prices for small users substantially, and the wireline firm bumped up its price to large users a penny a minute. In the final year of the study, the wireline firm raised prices for all three classes of users, and the non-wireline firm raised prices for small users, remaining below the competition at all three levels.

Such manipulations play hob with the indices. The mean PPI for the wireline firm is 3.39, below the 56-firm mean, while the 1990 price reductions earned the non-wireline firm a mean PPI of 6.29, well above the 56-firm mean. Continuing disparities

in prices earned the Phoenix market a mean price differentiation index of 8.95--slightly above the 28-market mean.

Segmentation performance was mixed, as well. The SI zoomed to 10 in 1988 and 1989, slightly above the 28-market mean, but dropped to 4 in 1990 and 6 in 1991. On the SDI, the last four years were 8.5, 8.75, 9 and 9, highest among the 28 markets, as the non-wire firm offered lots of free services to its customers. The wireline firm continued to charge extra for many of the same services.

<u>Pittsburgh</u>	PPI-1	4.05	PPI-2	9.02	PPI-M	6.54
Competitive rating: Moderate	PDI	1.55	SDI	7.29	SI	6.29

In the Pittsburgh market, prices trended downwards except for small users, resulting in fairly favorable PPI numbers. The wireline firm, with two years of noncompetitive operation, scored 4.05 on the price performance index, slightly less than the 56-firm mean, while the non-wireline firm scored 9.02. Both firms cut prices sharply for medium and large users in 1991, but the effect of the cut had a much greater effect on the PPI of the non-wireline firm because it had only three previous years of price history.

The firms maintained little difference between their price levels, however, resulting in a price difference index mean of only 1.55.

On the segmentation index, Pittsburgh was generally below the 28-market mean, and the number of price plans offered declined to 7 in 1991. Service differentiation showed Pittsburgh generally higher than other markets, reaching 8.5 in 1990 and 1991 compared to a 28-market high of 6.66 in 1991.

<u>Portland</u>	PPI-1	5.71	PPI-2	11.88	PPI-M	8.80
Competitive rating: Moderate	PDI	9.87	SDI	5.38	SI	8.33

Price-cutting in Portland in 1988 and 1991 earned that market favorable PPI ratings. The non-wireline firm lowered prices for all three classes of users in 1988 and again in 1991 to earn an overall PPI of 11.88, the highest among the 56 firms. The wireline firm cut prices to two classes in 1988 and to the third class in 1989, but did not respond to its competitor's reductions in 1991. It had an overall PPI of 5.71, well above the 56-firm mean. Although there was a price difference between the firms in most periods for most classes, it was generally not a big one, so the market scored 9.87 overall on the price difference index, just a bit above the 28-market mean.

On both the SI and the SDI, Portland tended to be close to the 28-market means in most periods.

<u>St. Louis</u>	PPI-1	3.90	PPI-2	5.60	PPI-M	4.75
Competitive rating: Low	PDI	2.21	SDI	4.36	SI	10.00

The St. Louis wireline firm had set its prices by 1985 and never changed them for the period of the study. As a result, it earned a PPI exactly the same as the average CPI annual increase of 3.90. The non-wireline competitor, which began service on the same date as the wireline firm in July 1984, accepted the wireline firm's prices in most periods. The non-wireline firm started out higher in one class at the start of 1985, cut its prices that year below the competition, then increased the price to match the wireline firm. The non-wireline firm also reduced its price to one class in the period ending January 1991. These scattered price changes gave the non-wireline firm a PPI of 5.60.

St. Louis exceeded the 28-market mean on the segmentation index in most periods, but lagged the 28-market mean on the service differentiation index in every period.

<u>San Diego</u>	PPI-1	-1.11	PPI-2	6.56	PPI-M	2.72
Competitive rating: Moderate	PDI	16.97	SDI	4.17	SI	4.50

Pricing anomalies skew the indicators in the San Diego market. For medium and large users, both firms maintained stable prices, with a difference of 5 cents per minute between the rate levels for those two classes. The wireline firm did reduce prices for larger users in some periods, but even then, its per-minute rate remained higher.

For small users, however, the wireline firm in 1987 created a new rate plan with a low monthly fee and much higher per-minute fee. The non-wireline firm did not create such a new plan, but retained its lowest plan with its higher access fee and lower per-minute charge. Thus in the comparison based on per-minute costs, it appears much lower, and the wireline firm gets a negative PPI for introducing higher per-minute rates for small users.

The result is an overall PPI of -1.11 for the wireline firm, primarily because of the one-time institution of the new plan for small users, and a PPI of 6.56 for the non-wireline firm, primarily the result of a one-time rate reduction for two classes in 1988.

The price difference index is perhaps a better measure of competition in the San Diego market. In most time periods, for most rate classes, the firms maintained a substantial disparity in prices. Thus, the market earned an overall PDI of 16.97, third highest among the 28 markets.

On the SI and SDI scales, San Diego looks less competitive. The two firms consistently offered fewer retail plans than firms in most other markets. The San Diego market consistently rated far below the 28-market mean on the SDI as well. Both firms offered fewer service enhancements than most firms in other markets, and the wireline firm maintained its policy of charging for most service enhancements.

San Francisco - San Jose

Competitive rating: Low

PPI-1	-2.71	PPI-2	-3.09	PPI-M	-2.90
PDI	0.00	SDI	5.33	SI	3.67

The sprawling San Francisco - San Jose market was arguably the least competitive among the 28 major markets. The wireline firm began the period with a per-minute price of 45 cents for all customer classes, and when the non-wireline firm entered in 1986, it matched this pricing system. Both firms doubled the per-minute price for the smallest users in 1988, but held all other prices constant, as measured by the PPI. The market thus earned a mean PPI of -2.90, lowest among the 28 markets.

Nor did San Francisco look any better on the PDI, scoring a flat zero--the only market besides Atlanta to do so for the entire period.

San Francisco was also at the bottom of the list on the SI, scoring a mere 3.67, lowest in the study, compared to the national mean of 7.97. Only on the SDI did San Francisco show any serious sign of competitive behavior, with a seven-year mean of 5.33, slightly about the national mean of 5.21.

<u>Seattle</u>	PPI-1	2.733	PPI-2	2.732	PPI-M	2.73
Competitive rating: Low	PDI	10.21	SDI	6.04	SI	9.00

The Seattle market was one of the few which overall experienced an increase in prices over the seven-year period. This overall increase was less than the inflation rate, but it still represents an unusual situation. The increase was not a steady one, however. Both firms reduced as well as raised prices at various times. The index numbers are further confused by the fact that the non-wireline firm, which had maintained a high price level for small users, drastically reduced that user class's price in the period up to January 1990, the same period in which it raised prices for the two other user classes. At that time, the non-wireline firm completely revised its price structure, eliminating the plan for small users with the low access charge and high per-minute charge. The wireline firm responded by reducing prices to its smallest users, at the same time raising prices for the two other groups. In the final year of the study, the wireline firm again raised prices to all three classes.

This upward, albeit irregular, trend in prices is accurately reflected in the price performance indices for the two firms. The wireline firm scored an overall 2.733 on the PPI, and the non-wireline firm had a nearly identical 2.732.

With all of this price manipulation, it is hardly surprising that the two firms usually posted different prices for the same user groups. Thus, the composite PDI index registers 10.21, indicating a moderately high level of competition reflected in price differences.

The segmentation index shows an unusual pattern. Retail price plans proliferated in Seattle early in the period, reaching a high of 13 in 1988, well above the 28-market mean. The firms simplified their prices structures thereafter, however, resulting in a decline to 7 in 1990 and 8 in 1991, well below the 28-market means for those years.

Competition as reflected on the service differentiation index was above the 28-market mean for every period, ending at 8.5 in 1991, tied for third highest in the study.

<u>Tampa</u>	PPI-1	4.98	PPI-2	4.24	PPI-M	4.61
Competitive rating: Moderate	PDI	6.39	SDI	4.25	SI	6.14

The Tampa wireline firm had nearly three years without competition before the non-wireline firm began operations. The wireline firm reduced its prices substantially in the period before January 1988, the period when the competitor entered the market. Generally, however, prices were stable otherwise, except in 1991, when the non-wireline firm raised prices to two classes of users. The non-wireline firm consistently offered lower prices to small users, but its prices to medium and large users were usually the same or similar to the wireline firm.

Both the price performance index and price difference index are indicative of moderate competition. The overall PPI for the wireline firm was 4.98, above the 56-firm mean of 4.34, and that of the non-wireline firm was 4.24. The wireline firm's PPI

benefited from its price cuts at the time of entry of the competitor. On the PDI scale, the Tampa market scored 6.39, below the 28-market mean of 8.86.

Segmentation lagged behind the 28-market means as long as there was no competition, not surprisingly. Retail price plans burgeoned after 1988, however, reaching 13 in 1990 and 12 in 1991, both above the 28-market means. Service differentiation in the two-firm market followed closely the 28-market mean.

Analysis and Discussion

Patterns and relationships are quite unclear in this review of 28 markets and 56 pioneer firms in the U. S. cellular telephone industry. The industry structure of the 28 markets is identical, but that did not result in any uniformity of behavior. Why do some markets develop patterns of frequent price adjustments? Why do others compile a record of rarely changing prices? Why do firms in some markets develop a wide variety of retail price plans, while others utilize fewer? Why do some firms charge for the same service enhancements given free to customers by other firms?

The pricing data available, and the preceding analyses of it, suggest few answers or even theories to answer the above questions.

While we have no comprehensive data, there are few reports in the trade literature of high call blocking rates during the period studied, except in certain cells in the crowded New York and Los Angeles markets. There is no evidence of capacity constraints on any widespread basis. Since capacity in the relevant range appears to be ample in most markets, both theory and logic tell us that competition should tend to drive prices toward marginal cost. If technologically and financially possible, competitive firms should seek to offer improvements to their service and pricing plans to appeal to identifiable market segments.

All four forms of competitive behavior covered in this study have been used by cellular firms in some of the 28 markets at various times. However, virtually no firms

made heavy use, compared to other firms, of all four types of competitive behavior. Conversely, most of the firms who overall were the least competitive made at least moderate use of one or more forms of competitive tactic. No market is completely lacking in behaviors which have elements of competition.

Rankings and Comparisons

Comparisons of the relative use of different competitive tactics by the various markets and firms may be seen in Appendices G and H. In Appendix G, markets are rank ordered from highest to lowest on each of the four indices. In Appendix H, firms are similarly rank ordered on the PPI. Appendix G separates the markets into four quartiles. Appendix H divides the firms into four quartiles.

Appendix G reveals the lack of consistency within markets regarding competitive behavior. Markets which rate high on one index of competitive behavior do not necessarily rate high on the other indices.

While competition is not necessarily the only reason to reduce prices, price reduction is certainly compatible, or even expected, under competitive conditions. A comparison of the markets which rank highest on the PPI, indicative of a tendency to reduce prices, does not reveal any pronounced tendency toward other competitive behavior. Portland, the market where prices went down the most, does not rank in the top quartile in any other competitive behavior. Indianapolis, the second-ranked market on the PPI, ranked in the upper quartile on one other index and near the top of the second quartile on another. Chicago, third on the PPI, was the only market of all 28 which ranked in the upper quartile on all four indices.

And so it goes. Pittsburgh, Houston and Minneapolis were in the upper quartile on the PPI, but each ranked in the upper quartile on only one other index. Atlanta did not make the upper quartile on any other index.

The lack of consistency is even more pronounced among the top markets on the price difference index. None of the three highest markets on this index ranked in the top quartile on any other index.

Only at the bottom end of the rank order lists does there seem to be some consistency. San Francisco-San Jose ranked last on three of the four indices. Los Angeles was in the fourth quartile on the two price-related indices, and the third quartile on the SDI. San Diego was in the fourth quartile on three of the four indices. Of the 28 markets, only the three in California were so consistently near the bottom of the rankings.

A note of caution: The distinction must be made between the objectives of competition, and competitive behavior. We have proceeded on the principle that the primary economic objective, economic efficiency, is best served by pushing prices toward marginal cost, which is presumed to be below what firms will charge if left unregulated in a less-than-perfect competitive environment. Assuming that current dollar costs tend to rise, as does the consumer price index, the behavior of firms in either reducing prices or holding them constant is behavior which must be viewed as positive. That does not tell us, however, how much lower services could be priced and still cover the firm's revenue requirement.

Seen from another perspective: Conceivably, a market can have low prices without competitive behavior, or competitive behavior which does not result, at least in the short run, in low prices. The latter observation is consistent with oligopoly theory, which posits that prices will be higher than they would be under conditions of perfect competition.

It should be noted that the PPI and PDI are quite different in the nature of the phenomena which they operationalize and measure. The price performance indicator is precisely that--a measure of changes in price, designed to show downward movement as positive. The price difference indicator, by contrast, is a measure of both firms'

behavior, relative to the other firm in the market, which may or may not result in downward price movement. It is not difficult to see how the two indicators might not necessarily give similar results.

We have resisted the urge to compare prices between markets, because it is impossible to tell whether conditions in different markets would permit prices to be set at comparable levels and still meet the economic criteria. It is fairly obvious that conditions in the sprawling, auto-dependent Los Angeles market are quite different than in the more compact Eastern cities where public transportation is more widely used. Geographic size and population may be important variables in determining both costs and demand curves.

Although there is a mild positive correlation between the two price-related indices, it is clear that they are not closely related in terms of identifying underlying competitive behavior patterns. In too many cases, a pattern of price stability--not a strong indicator of competition--will be present in the same market where there are continuing price differences between the two firms--strong evidence of competition. In some markets--Buffalo being the outstanding example--prices were generally well below those in other markets, yet the behavioral indicators do not reflect a high degree of competition. One might suggest that prices were already so low that the two firms had limited incentive or leeway to reduce them further, thus appearing to be not competing strenuously. Or perhaps competition was so strenuous from the beginning that neither firm ever had the opportunity to raise prices and therefore did not reduce them.

The contrast between the firms who ranked high on the price-related indices and those who scored well on the non-price-related indices is worth noting. Cincinnati was in the top quartile on the SDI and led the second quartile on the SI, but scored poorly on the price-related indices. Buffalo, Los Angeles, St. Louis, Phoenix and Philadelphia

each scored well on one non-price related index, but failed to make the top quartile on any other index.

An examination of the markets which scored lowest on the price performance index reveals a similar lack of consistency or patterns. San Francisco-San Jose placed dead last on three indices, including the PPI, yet was in the top quartile on the SDI. Of the seven markets in the bottom PPI quartile, five scored in the top quartile on one other index. San Diego was in the bottom quartile on three indices, the top quartile on the fourth.

Various idiosyncratic explanations can be posited for some cases. Buffalo prices were generally among the lowest in the country. So it might not be logical for Buffalo to rank high on the PPI or PDI. Perhaps Buffalo prices could not be pushed much lower. The giant, diverse Los Angeles market may have spawned more retail price plans simply because the potential was there for more market segmentation. That argument fails to explain several other cities in the top quartile on the SI, however.

These foregoing observations are borne out by tests to correlate the rank order lists. Because the indices are not comparable, direct correlations of them would have little validity. However, a correlation of the rank orders, shown in Appendix I, provides very little support for the conclusion that the four indices are related to one another. The rank orders on the four indices were correlated, resulting in six cross-correlations. The results show very low positive correlations on four tests, and low negative correlations on the other two. The highest correlation is between the segmentation index and the service differentiation index at .2255. Next highest was the price performance index with the price difference index at .1312. The price difference index and segmentation index correlated at .1284. The other cross-correlations were either negative or close to zero.

Does this lack of pattern indicate that duopoly structure did not foster competition? That conclusion is not necessarily true. What we can safely conclude

from the data and analysis is this: Overall, prices did not rise with inflation. The 28-market mean for the PPI indicates that overall, prices declined during the period in constant dollar terms. Adjusted for inflation, the mean PPI declined at an annual rate of 4.26 percent. Overall, the number of price plans increased for several years, and the number of service enhancements trended upward throughout the study. These are indications that firms were continually trying various tactics to win customers. While these behaviors and results are not absolute proof of effective competition, they certainly are strong evidence that some competition is operative.

A comment on discriminatory pricing: This practice is customarily used as a tactic to extract higher prices from customer groups who have less elastic demand curves, and who therefore are willing to pay more for the service. The classic example is the airline business traveler, who in many cases pays a higher price than the pleasure or casual traveler, whose demand is more elastic. In regulated utility markets, businesses often pay higher rates for services. In local cellular markets, however, the pricing tends to be the opposite: User groups who logically should have less elastic demand curves may be able to pay less, because price structures are designed to attract and serve the large customers. The cross-elasticity created by having a choice of vendors may also be a factor in lower prices. Another factor could be the structure, in which two vendors with clear market power face a large number of demanders, some of which may also be large enough to exercise market power, particularly in an infant industry. A profile of customers would very possibly reveal a two-tier market, one consisting of many small customers and the other of a small number of large ones.

A distinction should be drawn between access fees and local calling fees, which in cellular are based on the length of time of the call. Access fees are commonly higher for the high volume customers, but that in turn qualifies them for lower per-minute rates. This constitutes a curious blend of discriminatory pricing, cost-based pricing, and competitive pricing. The access fee is discriminatory, in effect, because it falls

more heavily on the inelastic demand customer. However, unlike the case in most regulated utility settings, it is optional to the extent that the customer can choose a plan with a lower access fee. The customer is enticed to pay the higher access fee by the lower per-minute rates. For volume users, the cost per call or per minute is usually lower than if the customer paid a lower access fee and a higher per-minute rate. Examining the variable fees, we find that, although the prices may be low, they are still probably well above the marginal cost of calling, which is close to zero. Competition is probably encouraging the vendor to keep those costs low, because the other firm in the market can do so for the same reasons. So the firms have both competition and their cost structures in mind when they design their rate structures.

The distribution of the markets across the low to high competition was quite even. Of the 28 markets, 8 were rated as having low competition, 13 moderate, and 7 high. However, since the 28-market means were used as the standard for the non-price-related indices, this is less surprising than it might seem at first.

What is more notable is that in nearly every market, prices either dropped or rose more slowly than the consumer price index. Even in most markets rated as having low competition, price increases were few, and price level changes were favorable compared with the CPI. Cellular telephone users were the beneficiaries, although it is difficult to ascribe the cause of the positive price trend. Declining costs of operation, or the ability of cellular firms to spread the high fixed costs over a growing customer base, may well have contributed to lower prices.

Four sets of behaviors are examined over a seven-year period to ascertain whether cellular telephone firms act as if they are competitive. In virtually every market, there are positive indications of behavior which could be construed as competitive. The forms of behavior and the vigor of the behavior vary widely, however, and the patterns are anything but clear. Results are encouraging, because over the 28 markets, quoted prices drop slowly and steadily during the period, and the

drop is substantial when measured against the steadily rising CPI. It is impossible to say with any certainty that this favorable price behavior is the specific and sole result of competition, or that it would not have taken place under regulation or a different market structure.

Performance vs. Predictions

How well does the industry, as reflected in the first 28 markets, perform compared to predictions in Chapter 3 based on the model and theory?

Price behavior. Although it is impossible to tell how much prices moved toward marginal costs, it is clear that on average, prices decreased in the 28 markets during the seven-year period under study. Adjusted for inflation, as reflected in the consumer price index, prices decreased significantly--at an annual average rate of 4.26 percent per year. At the end of the period, the mean of all prices, as determined by the PPI, was 22.1 percent lower in constant dollar terms than at the beginning.¹

Theory suggests that prices under duopoly will be lower than under an unregulated monopoly, but higher than under perfect competition. Not having either real-world model available in a similar industry for direct comparison, it cannot be said definitively that this is the case. It is not illogical to assume, however, that under most market structure models, prices would have risen roughly in synchronization with the CPI, if only because customers would probably accept it.

It is possible that a regulatory mechanism could have forced real prices down as much or more than the competitive pressures of duopoly. Again, we have no model to use for comparative purposes, but we can look to the experience of California, apparently the only state to rigorously regulate cellular telephone rates in much the same way as conventional wireline telephone systems. We find that prices trend downward more strongly in the 25 markets outside of California during this seven-year period than they did in California under such a regulatory regime. Two California

markets were toward the lower end as measured by the various scales of competition, and San Francisco-San Jose was easily the least competitive in the whole country. San Diego was rated moderately competitive, but one firm had a negative PPI.

Non-price competition. An interesting pattern emerges when we look at markets where there appears to be little price competition. In most of these markets, there is active competition in non-price areas, specifically in providing enhanced services and in offering more varied pricing packages. These are reflected in the SDI and SI, which are indicators of competitive behavior not specifically related to pricing. When correlations were run on rank-ordered data for the four indices, weak positive correlations were found between the two price-related indices and the two non-price-related indices. Weak negative, virtually neutral, and weak positive correlations were found between the price-related indices and the non-price-related indices.

What this means is that firms in markets with strong price competition were not particularly likely to also compete vigorously using non-price-related tactics, and vice versa. This observation is verified by the market-by-market analysis. This is consistent with the prediction that where price competition is not vigorous, firms are likely to compete in other ways. There is no current theoretical support for the converse, however.

Price structures. The two-part price structure, with a fixed monthly access fee and a variable usage fee, is nearly universal in the original 28 cellular markets for the period studied. There are a few, short-lived cases where there is no entry fee, and one suspects that these are introductory pricing tactics. There are no data available concerning free access offered on a short-term promotional basis. Peak load pricing is also widely available, although there is no reason to consider this primarily a competitive technique. More likely, it is a tactic to attract business for off-peak hours when there is plenty of capacity and very low marginal costs.

To the extent that some user classes pay higher access fees, one could say that cross-subsidies may be taking place. The same logic holds on the variable usage fees as well, especially during off-peak hours. To the extent that usage fees exceed marginal cost and exceed usage fees for other customers, they could be regarded as some sort of cross-subsidy. However, unlike the case of many regulated and monopoly industries, the cross-subsidies are voluntary, in return for other apparent advantages for large users.

Consumer surplus. It is impossible to quantify consumer surplus, because we cannot estimate the demand curves from the available data, nor can we obtain market-level data on the number of customers, volume of calls, etc. However, if the inference is correct that prices are lower under the duopoly structure than they would have been under either an unregulated or a regulated monopoly regime, the conclusion can be drawn that consumer surplus has been increased, as well as the total of both consumer and producer surplus. This conclusion can only be reached by deduction, however, and not by empirical means.

Market leadership. It is clear that at least in some markets, there is either price leadership by one firm or tacit collusion on prices. In two of the 28 markets, there is an unbroken pattern of identical pricing. In many others, there are occasional examples and sometimes long-standing patterns of identical or similar prices. In some markets, there are price disparities in some classes, but not in others. There is no discernible pattern as to which classes are likely to be more or less competitive. In some markets, there appears to be serious price competition for the small users' business, while in others the competition is for the large customer. There is some evidence that when the wireline firm has a substantial head start in the market, it is able to sustain higher prices in the face of competition from a non-wireline entrant.

Policy Assessments

Let us now return to the six policy issues presented at the end of Chapter 3 and see what the analysis indicates:

1. Is the duopoly structure of the local cellular telephone market likely to increase access to telephone systems to consumers who cannot presently get such access? Can public policy formulators take advantage of cellular market conditions to extend accessibility and pursue the goal of universal service?

There is no evidence in this study that duopoly structure will increase access to the public telephone system. Generally speaking, cellular access fees even for small users are high compared to public switched telephone network prices, and the high per-minute prices serve to make total calling costs much higher. This could change, but the initial seven years provides no basis for optimism on this policy issue.

A promising extension of cellular technology could be to provide access in remote locations where building wireline facilities for scattered customers is costly. Cellular provides an alternate means of providing telephone service, possibly at a lower cost per potential subscriber, especially in sparsely populated areas.

The customary two-part pricing system provides an opportunity to develop special prices and subsidies for consumer segments which have difficulty paying for access to telephone service. One possibility would be to reduce or subsidize access fees for low-income citizens, then let them pay the variable charges associated with use of the system. At current per-minute prices, this may not seem viable, but as local wireline rates and cellular rates converge, this may become an attractive possibility for public policy purposes.

The sustainability of cross-subsidies between customer groups is unlikely, because one firm will be motivated to cream-skim by undercutting the higher fees of its

competitor, in the absence of either collusion or a regulatory requirement to cross-subsidize.

2. Does duopoly structure encourage high quality telephone service?

The data from this study provide little insight as to the quality of service. We know from isolated reports that some high volume cells in some markets have been chronically overloaded at peak calling hours, causing call blocking rates that probably would be considered unacceptable in U. S. wireline systems. As traffic builds, this will happen more often, unless cellular firms expand cell sites in busy areas to stay ahead of the peak demand. We can expect that firms which do not increase cell capacity to meet peak demand will lose business to competing firms which are able to do so, but this study provides us with little information on whether that has been happening. In 1991, the final year of this study, the industry was probably still so young that it was too early to tell.

3. Does duopoly structure serve to encourage innovation and development of the telephone system?

During the period of this study, cellular telephone was still a young industry. As such, it could be said that both the cellular firms and their customers were innovators and early adopters, in diffusion literature terminology. Although the four indicators were not specifically designed to reflect change and innovation, all four are influenced by change. In many of the markets, the frequency of changes in both prices and pricing plans reflect the propensity of the firms to experiment, hoping to improve their financial and marketing performance. In a more specific way, the proliferation of enhancements, shown by the SDI, is an indication of the desire of the firms to improve their service, or at least the public perception of improved service. It is unlikely that, without competition, the cellular firms would have offered as many enhancements or pricing plans.

4. Can oligopolistic behavior which is counter to consumer interests be prevented or minimized within a duopolistic environment? Is the observed performance an improvement over the performance of regulated monopolies in the telephone industry?

In those markets rated as having low or moderate competition, firm behavior is often exhibited which would be considered normal for oligopolies. As noted earlier, there are signs of tacit collusion on prices, as well as price leadership by firms which appear to have market dominance. These are manifestations of the exercise of market power which can be expected in oligopolies. Since, by definition, duopoly is a form of oligopoly, it is hardly to be expected that oligopolistic behavior can be prevented, although to the extent that the firms engage in vigorous competition, perhaps the worst excesses of oligopoly can be avoided. It is difficult to explain, however, why competition seems to flourish in some markets, yet be virtually absent in others, when all have the same market structure. Market structure is probably not the sole determinant of competitive behavior or results.

On the basis of this study, we have to conclude that cellular telephone performance in matters related to public policy is not an improvement over the recent performance of the wireline telephone providers. Prices are much higher, the service quality is no better, if as good, and cellular is less accessible to those of limited means. However, seven years may not be enough time for the industry to reach the mature stage where it needs to appeal to the broadest possible market and price competitively to fully exploit that market. If strenuous competition becomes a widespread characteristic of the industry, there appears to be no intrinsic reason why it could not match the performance of the wireline industry. It must be remembered, however, that regulators have traditionally required that wireline companies depreciate fixed assets--a major cost component--over very long periods, which contributed to the apparent low telephone costs, or at least low prices. In addition, cross-subsidies from business and long

distance service have contributed substantially to the low prices for local residential service. Such cross-subsidies are not likely to exist or develop in the lightly regulated cellular industry, as it is now constituted, and indeed are expected to decrease and eventually disappear in local wireline markets.

The result may be that, in the future, local phone rates will rise substantially, gradually closing the gap as cellular costs continue to drop or hold steady. The result is likely to be improved economic efficiency, but not necessarily low rates for subscribers of either the wireline or cellular networks, compared to what local telephone rates have historically been in the last half century.

5. Is rate regulation justified or desirable?

There seems to be no need or justification for rate regulation based on the findings of this study. With a well-developed wireline system in place, cellular can hardly be considered a vital service and therefore one requiring regulation. Behaviors of firms and markets reflected in this study are not indicative of monopoly behavior. Evidence pointing to collusive behavior or excessive profits is very limited; in fact evidence of competition appears to be stronger than theory-based predictions might indicate. With the general trend toward deregulation in telecommunications, there is no compelling reason to single out cellular for more economic regulation. The only policy objective which might be served by increased regulation is access for those who cannot afford telephone service. While regulation might suggest a solution to the access problem, other means can also be considered which do not involve additional regulatory rules or oversight.

6. Will the various segments of society receive fair treatment in reference to access to the technology under a duopoly market regime?

Fair is a difficult word to apply in specific cases, as has been discussed earlier, and defining fairness in relation to a new communication technology is not simple. In economic terms, access seems to be equitable, in that anyone who is willing to pay is

given access. The cellular companies even make it possible for small users to pay lower access fees, although these small users usually pay more per minute to place their calls. This is not so different in concept from pricing practices for many other goods and services, for which volume purchasers pay lower rates. At present, however, cellular is not an inexpensive service, compared to other voice services available. The industry is still dealing with high capital costs, and until these are depreciated, it faces substantial revenue requirement constraints. If the industry does not get left behind by technology, forcing costly upgrading, the longer term prospects seem good for lower rates and therefore wider access.

Summary

1. Duopoly has, in the case of cellular telephone, resulted in local markets which can be characterized as moderately competitive.
2. Prices have quite consistently decreased, when adjusted for inflation. Overall, the decrease has been moderate and gradual.
3. It is reasonable to conclude that price P has been moving toward marginal cost MC , which means that the economic efficiency of local cellular markets is improving.
4. These moderately competitive conditions are not likely to result in a reallocation of resources which will broaden access to the system for those least able to pay.
5. These moderately competitive conditions do, overall, encourage high quality service and technological development.
6. Under current conditions (i.e., a well-developed public switched telephone network and increasing competition from other technologies), there seems to be no pressing reason, either economic or social, to subject cellular telephone service to rate regulation.

Note

¹ This is the author's computation, based on the mean PPI in this study. The U. S. General Accounting Office, using data from the same original source analyzed according to different methodology, estimated that real price decreases (adjusted for inflation) averaged 27 percent in the same period in the same markets (Anderson, 1993). The GAO estimate is possibly more accurate, because the mean PPI in this study is not weighted to reflect the distribution of the consumers under actual market conditions.

CHAPTER 5

CONCLUSIONS AND SUGGESTED FURTHER RESEARCH

Cellular telephone is one of several new and developing technologies providing new communication channels for voice and data transmission. It has been offered primarily as an extension of the conventional wireline telephone system, although there is no inherent reason why it cannot replace or extend wireline in some situations. If Negroponte (1993) is correct, radio may become the channel of choice for point-to-point and person-to-person communication in the future, as the video media move to cable-based transmission and vacate portions of the spectrum.

The trend to more specialized and even individualized media is continuing in the U.S. and other developed countries. For the most part, the traditional mass media have plateaued, and the fragmented media are the ones experiencing growth. Cellular is just one of the channels benefiting from this trend.

As a new technology, cellular was in the innovator and possibly early adopter stages of diffusion during the period of this study, 1985-91. In these development stages, any attempt to predict long term market potential is pretty speculative, especially for a technology which has some reasonably close substitutes. During this period, however, the growth rate is still very high, which means that demand curves are shifting and unstable. User behavior, as reflected in market data, is a moving target, and standard communication and economic theory is of limited use in predicting long term patterns.

Making the situation more complex is the fact that the telephone is used for a variety of purposes. Voice telephone use can be broadly classified by instrumental

(business) or instrumental (social) purposes, and the two classes of users have different characteristics. These characteristics influence the demand curves, which have differing elasticities, because users are likely to assign different values to the two types of use. Cellular phone firms use a variety of pricing plans to get the users to self-select into different customer groups.

Due to the odd, dynamic situation in which the FCC found itself in the early 1980s, the cellular telephone industry was structured as a series of local duopolies--markets with only two firms supplying the service. This structure provided an unusual opportunity to study the behavior of firms in duopoly markets and assess the results in terms of public policy objectives. That was the purpose of this study. An extensive data set from the early period of cellular telephone growth made it possible to study four different types of typical competitive behavior in the first 28 cellular markets. The initial purpose of the study was to determine the degree to which competitive behavior was operative in these duopoly markets. The second purpose was to determine how effective this behavior is in meeting six specific public policy objectives in the telephone field.

The methodology involved building four indices which measure four discrete forms of competitive behavior. These indices measure price level changes, price differences between competing firms, market segmentation through different pricing plans, and product differentiation by means of the addition of service enhancements. Each market was evaluated in terms of the intensity of competitive behavior and conclusions drawn for the group of 28 markets. Overall results were also compared with the theoretical model of duopolistic competition. The results of this competition under duopoly were discussed in terms of the six desired policy objectives.

The markets varied in the intensity of competition from quite low to very high. All four forms of competitive behavior occurred in various markets, but no single form of competitive behavior occurred in all or even most markets. No market exhibited all

four forms of competitive behavior, and no market was completely lacking in all four competitive behaviors. Therefore, we determined that all markets exhibited some degree of competitive behavior, and some appeared to be very competitive.

To maximize total consumer benefit, economists consider it desirable to encourage the lowest prices consistent with the ability of the firms to stay in business. It is axiomatic that competition should drive prices down, and that consumers as a whole will benefit from this result. However, other more specific policy objectives traditionally highly valued under American regulatory regimes may not be best served by just reducing overall price levels. Specifically, the goals of providing universal service, and providing an adequate level of service to those with possible emergency needs may require more targeted policies than competition permits.

Economic Issues

Every market seems to have a different set of behaviors. No two are even similar. Because of this, even broad patterns are difficult to discern, and analysis of the data cannot be considered definitive. Some significant observations and conclusions can be made, however.

1. There are no markets in which evidence of competition is totally lacking. In virtually every market, the overall rate of price increases was less than the inflation rate, suggesting there was something restraining increases. Economic theory offers two sources of such restraint: Competition and elasticity of demand. Response to elasticity suggests that a firm or an industry may be able to increase profits by reducing prices, because the increase in customer base will more than compensate for the reduction in revenue per customer. This is especially likely to be the case when a firm faces low marginal costs, such as is generally the case in cellular telephone, as long as the marginal revenue exceeds marginal cost.

2. In a number of markets, the entry of the second firm coincided with major price reductions by the first firm. This is strong evidence of the impact of competition. A number of other instances can be cited where competing firms either reduced their prices in the same time period, or a firm reduced its price in the time period following the one in which its competitor did the same.

3. Differences in price between competing firms were widespread, and often substantial in magnitude. Some of these may be attributable to the variety of pricing structures, which occasionally makes comparison imprecise. However in most markets, for most classes, where a disparity of prices is evident, the customer would have enough information to make an informed comparison on the basis of his expected use, and make a choice. Therefore, we can conclude that price differences offer a clear choice for many consumers, and that firms are using them as a legitimate competitive tactic.

4. The offering of service enhancements, the cellular version of product differentiation, does not appear to be aggressively used as a competitive tactic. Such enhancements increase gradually throughout the study, though the rate of increase slows to a crawl after 1988. It appears to be relatively easy for a firm to match the service enhancements offered by its competitor, since many are no more than software improvements. The fact that many firms do not charge for these enhancements indicates they do not represent a significant cost to firms adopting them. Since we do not have market penetration or market share data, we can make no judgments about the effectiveness of such enhancements in attracting business, or persuading customers to switch vendors. The observation that new enhancements are usually offered by both firms in a market, albeit for a fee by some firms and free by others, indicates that they are not important competitive tools in the cellular industry.

5. Market segmentation, in the form of multiple pricing plans, is widely used as a strategy. Unlike some industries, cellular telephone has not found it feasible to

implement enforced price discrimination based on arbitrary criteria. Except for local government, treated as a separate (and low priced) class in a few markets, the selection of pricing plan is left to the customer, and presumably the customer makes the choice based on expected usage patterns. By creating and frequently changing multiple pricing plans, management may be groping to fit a self-selecting price discrimination policy to an unknown set of demand curves, and thereby convert some consumer surplus to producer surplus. However, the self-selecting nature of the plans make it unlikely that such a strategy would have much success, because consumers can select the plan they feel will yield them the greatest utility, and competition would tend to minimize the ability of the firm to extract more consumer surplus.

6. The overall conclusion is that the cellular telephone industry, on the local level, is at least moderately competitive. Effective competitive behavior is evidenced primarily through price-related actions. The two types of non-price-related behavior tested in this study did not appear effective in terms of competitive results.

Because cellular telephone is presently perceived and priced as a premium, nonessential service, pricing issues are important primarily to those who stand to reap the amount of utility which justifies paying prices which are high compared to wireline service. The 1996 act, however, may possibly change that. As the cost and competitive environments change in the telephone industry, cellular may find itself cost-competitive, especially in the rural, insular or high cost service areas targeted for subsidies by the act. If cellular providers are deemed eligible for subsidies in such areas, they could supplement or supplant wireline service providers. This possibility would place new emphasis on the desirability of competitive behavior, both within the cellular industry and among cellular and wireline providers and any new entrants such as personal communication services.

With cellular in its present role as an extension of wireline service, network externalities are relatively unimportant in cellular pricing and value. If, however, the

changing technological and pricing environments make cellular providers predominant in local markets, increases in utility due to network externalities could become significant and thus deserve consideration in setting prices.

Public Policy Issues

1. Increased access and further progress toward truly universal service appear to be unlikely to develop in the cellular telephone sector, as in the rest of the telephone industry, in a totally free market environment. The competitive behaviors examined in this study do not appear to contribute much to the goal of universal service. By making cross-subsidies more difficult to sustain, the duopoly structure probably discourages further progress toward broader access and universal service. However, cellular technology may eventually offer a cost-effective substitute to the PSTN which can be utilized by policy makers to increase access, because individual service is inexpensive to provide, once a system is in place, and marginal costs should be low.

As variable rates drop, as they should in the increasingly competitive local phone market, and as the cellular firms depreciate their high initial investments, firms should become increasingly willing to accept low-income customers for a low access fee, with the customers paying the variable fees at regular or reduced rates. Society may be willing to subsidize such service.

At least four possible methods suggest themselves to utilize cellular to increase access to telephone services for low-income customers:

-- A government agency could bid out phone services for low-income users, awarding contracts to the vendors who offer the service for the lowest prices. This could stimulate competition between wireline telephone firms, cellular firms, and possibly firms entering the marketplace with new personal communication network (PCN) systems or cable TV.

-- By direct subsidy, perhaps through a voucher system similar to food stamps, the government could subsidize all or part of the monthly access fee for qualifying citizens. Again, this might be negotiated with the firms to get a reduced fee. The firms should realize that this is business which they would not otherwise have, and which adds little to their costs. If the subsidy equals or exceeds the customer's share of the fixed costs, the firms should be motivated to cooperate.

-- By regulatory fiat, the appropriate agency could simply require that cellular firms accept low-income subscribers. The costs would either be included in costs billed to other subscribers, or they could be offset by tax breaks to make the plan more palatable to the firms. There are details to be worked out, but the result would be a cross-subsidy situation not unlike that which existed for decades in the wireline telephone industry.

-- Under the directive of the Telecommunications Act of 1996, the FCC is moving toward a cross-subsidy model which is a variation on the traditional model of long distance services subsidizing local service. The act calls for all interstate telecommunications providers to be assessed to provide the funds necessary to subsidize specified classes of customers and providers. The recommendations of the Federal-State Joint Board on Universal Service, if adopted, would set up the system for administering the cross-subsidies (FCC NEWSReport No. DC 96-100).

2. Increasingly, cellular firms will realize that they are in competition with the PSTN, personal communications networks, and paging systems, and soon cable TV systems as well. The systems are not perfect substitutes for one another, but for many customers, the attributes of the technologies overlap. This increasing competition will provide cross-elasticities for many cellular customers, including those for whom mobility is an important advantage. This will create pressure to reduce prices, and because variable fees are probably well above marginal costs, the cellular firms have room to cut prices as a protective, competitive measure. The reduction of

interconnection charges with the PSTN, mandated by the Telecommunications Act of 1996, should assist this competitive response.

3. There are relatively few situations under which a sustained duopoly is likely to develop, except under regulated conditions which create entry barriers, such as exist in the cellular telephone industry. In most industries where two firms have a high degree of market share, the consumer probably has alternatives, and the fringe competition acts to inhibit and shape the behavior of the two firms. If a duopoly exists in a national market, protected from outside competition by trade or other barriers, the duopoly is likely to be the result of industry conditions related to efficiency and market size, which make it possible for two efficient firms to exist, but not three. Thus, it is rarely possible for public policy to either encourage or discourage the creation of duopoly markets.

Since duopolies are unlikely to develop in free market settings, the only real world application of the concept is likely to be in regulated markets. However, duopoly structure will be selected as a model for regulated markets only if the regulatory authorities find, as the FCC did with cellular, that technical and financial conditions permit two firms to provide comparable service with no detriment to the public.

4. The wireline phone companies, which presumed that they could dominate the cellular telephone business, argued before the FCC that local monopolies, such as were enjoyed by phone companies, would be the most efficient industry structure. The wireline firms have been a major force in cellular service, since they were automatically awarded a franchise in each market. Several of the regional Bell operating companies have become operators in other regions as well, successfully setting up "non-wireline" subsidiaries in other companies' local territories. So far, there is little evidence that single company service areas would have been more efficient or resulted in lower rates through economies of scale or scope. In a number of markets in this study, the wireline

companies had lead times ranging from a few months to two years or more, but their rates do not indicate that greater efficiency during these periods of unopposed business led them to offer lower rates. On the contrary, their initial rates were often high, and sometimes were reduced when a competitor entered the market.

5. There is no indication that state regulatory oversight has done a better job in holding rates down than natural competitive forces in other duopoly markets. Only one market and two firms in other markets had negative price performance index scores for the 1985-91 period, all in California, the state that exercised the most stringent regulatory oversight over cellular telephone. These were the San Francisco market and the wireline firms in the Los Angeles and San Diego markets. San Diego did score high on the price difference index, but several unregulated markets scored higher. San Francisco was the least competitive market among the 28, showing the lowest scores on three of the four indices of competitive behavior.

The development and growth of the cellular telephone industry is one indication that the demassification of mediated communication is continuing. Cellular is one more link connecting scattered, individual users--who may be mobile as well--with the global electronic network we regard as telephone service. Demassification is shifting the locus of control to the user and away from mass media or communications middleman organizations.

Cellular telephone has developed as a premium service, generally offered at prices significantly higher than local wireline service. This means that the cellular customers place a higher value on the service, at the margin, than do wireline customers. This would indicate that the perceived utility expected or derived from the service, which in turn is dependent on the value of the information or interaction possible, is greater, at least for customers at the margin. Indications are the cellular customers use the service primarily for business, not social, purposes. This is consistent with the theory that the value of information is related to its importance as an

economic input. Information often has time value as well. To the busy businessman, or the mobile user who needs information while moving from place to place, the extra cost of cellular must be justified by the extra value of information being immediately obtainable. We know that the ability to obtain information or to interact is about the same for cellular and wireline customers, because the two systems are interconnected. The only significant difference to the user is the mobility or portability of the cellular instrument, providing immediate access to information away from a stationary phone. Therefore, we must conclude that customers are motivated primarily by the mobility or portability of the cellular phone, and not by the value or nature of the information received or the interactive communication itself.

A new posture for the FCC has emerged, very similar to the model proposed by Horwitz (1989). Recent activities of the agency do not fit with the capture theory of regulation, or with the concept that the agency must take a comprehensive approach to regulation to protect public interests. Instead, the FCC, working conscientiously within the policies and constraints set by Congress, appears to be trying to balance or broker the interests of the various stakeholders, and regulate only to the point necessary to carry out the agency's mandate. This regulatory model is likely to become more commonplace, as the 20-year trend toward deregulation in the U.S. continues. Regulatory agencies that are not phased out entirely are likely to find that the role of mediator more nearly typifies their position and operating procedures than the traditional, more powerful, role of regulator.

Further Research

Much remains to be done in the way of empirical research on the subject of duopolies. The rarity of relatively pure duopoly structure means that opportunities to study it in detail are limited. There may be no other industry where duopoly structure

is replicated in a number of comparable markets and isolated enough to study in a meaningful fashion.

Using the Information Enterprises data set, a number of other aspects of cellular telephone could be fruitfully studied. Some of the behavior quantified in this study, or quantifiable, could be related to common ownership of local franchises by larger companies. Perhaps certain behaviors are related to specific decisions made by parent corporate management, or conditions specific to a corporate culture. Perhaps there are patterns of behavior which are related to the age and development stage of the market. There are indications that behavior is different when one competitor has a significant head start and is entrenched by the time the second firm enters the market.

Although the data were not available to this researcher, the degree of penetration and market share of each firm could be a significant factor, and their effects should be pursued. Over the longer term, it should be possible to gather data relating prices to the number of users in the market, and build estimates of the demand curves. The data used in this study were generated by an industry so young that demand had not stabilized by the end of the study period. Therefore, we cannot make inferences from these data about behavior under long term stable conditions.

Duopoly structure data might be used to study two specific economic phenomena: Cournot price leadership and price-taking. There are indications that both types of behavior might be taking place in at least some of the 28 cellular markets, but this study did not specifically attempt to isolate them or discern their effects.

Finally, more attention should be given to the behaviors measured by the segmentation index and the service differentiation index. Are these behaviors useful tactical tools for management to use in competitive situations, or are they ancillary to the basic tool of price? Are they only effective under certain conditions, and if so, what are the conditions? These tactics, ideally, should be studied across a number of industries, not just cellular telephony.

As noted elsewhere in this study, duopoly is frequently used as a model to test and illustrate a wide variety of economic phenomena. Very little empirical research has been done to determine whether these theoretical constructs accurately reflect field experience. The cellular telephone industry offers a rich field in which to test theory.

The cellular industry itself has received comparatively little scholarly attention. As new technologies such as personal communication networks open up the marketplace, cellular and similar channels offer interesting possibilities for study on how people communicate, and especially how communication habits are changing. It may be the appropriate time to build on previous work concerning uses of the conventional telephone, as well as new uses for the systems which were not possible a few years ago.

Finally, the public policy implications of duopoly structure have only been scratched. In many countries, market demand and spectrum limitations may require that other duopolies be created. This is especially likely in Europe, where policy makers are privatizing former government-owned telephone systems, and are experimenting with ways to substitute the marketplace for regulation by permitting competition on a limited scale.

APPENDIX A

SUMMARY OF DATA USED IN COMPUTATIONS

Prices in dollars per minute

Market/Date on line	Jan. 1985	Jan. 1986	Jan. 1987	Jan. 1988	Jan. 1989	Jan. 1990	Jan. 1991	Mean of Firm Prices	Mean of Mkt. Prices
ATLANTA-WL Firm 9/5/84									
Small user - 0-50 mins	0.40	0.35	0.35	0.35	0.35	0.35	0.35	0.357	
Med. user - 200 mins	0.38	0.25	0.25	0.25	0.25	0.25	0.25	0.269	
Large user - 500 mins	0.37	0.25	0.25	0.25	0.25	0.25	0.25	0.267	
Retail price plans	1	4	3	5	5	5	4		
Special features (chg.)	1	1	9	9	9	10	10		
Special features (free)	1	1	1	1	1	1	1		
ATLANTA-NWL Firm 2/5/87									
Small user - 0-50 mins				0.35	0.35	0.35	0.35	0.350	0.354
Med. user - 200 mins				0.25	0.25	0.25	0.25	0.250	0.259
Large user - 500 mins				0.25	0.25	0.25	0.25	0.250	0.259
Retail price plans				3	6	6	8		
Special features (chg.)				1	1	1	1		
Special features (free)				9	9	9	9		
BALT-WASH-WL Firm 4/2/84									
Small user - 0-50 mins	0.45	0.65	0.65	0.65	0.65	0.65	0.65	0.621	
Med. user - 200 mins	0.36	0.36	0.36	0.36	0.39	0.36	0.36	0.364	
Large user - 500 mins	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.360	
Retail price plans	6	5	5	6	6	6	5		
Special features (chg.)	3	3	3	5	5	5	5		
Special features (free)	6	6	6	6	6	6	6		
BALT-WASH-NWL Firm 12/16/83									
Small user - 0-50 mins	0.75	0.60	0.60	0.60	0.60	0.60	0.39	0.591	0.606
Med. user - 200 mins	0.40	0.40	0.40	0.40	0.40	0.40	0.49	0.413	0.389
Large user - 500 mins	0.40	0.36	0.36	0.36	0.36	0.40	0.39	0.376	0.368
Retail price plans	4	8	8	8	8	8	4		
Special features (chg.)	4	0	5	5	5	5	4		
Special features (free)	1	5	5	5	5	5	6		

Market/Date on line	Jan. 1985	Jan. 1986	Jan. 1987	Jan. 1988	Jan. 1989	Jan. 1990	Jan. 1991	Mean of Firm Prices	Mean of Mkt. Prices
BOSTON-WL Firm 1/1/85									
Small user - 0-50 mins	0.65	0.65	0.65	0.65	0.65	0.65	0.52	0.631	
Med. user - 200 mins	0.45	0.45	0.45	0.45	0.45	0.45	0.52	0.460	
Large user - 500 mins	0.35	0.35	0.35	0.35	0.35	0.35	0.42	0.360	
Retail price plans	5	5	5	5	5	5	5		
Special features (chg.)	3	7	7	4	4	5	5		
Special features (free)	0	0	0	3	3	3	3		
BOSTON-NWL Firm 1/1/85									
Small user - 0-50 mins	0.75	0.75	0.75	0.75	0.75	0.45	0.44	0.663	0.647
Med. user - 200 mins	0.44	0.42	0.42	0.42	0.42	0.42	0.42	0.423	0.441
Large user - 500 mins	0.44	0.35	0.35	0.35	0.35	0.35	0.35	0.363	0.361
Retail price plans	2	4	4	4	4	3	5		
Special features (chg.)	4	5	8	4	4	4	4		
Special features (free)	0	0	0	4	4	4	4		
BUFFALO-WL Firm 4/16/84									
Small user - 0-50 mins	0.40	0.40	0.40	0.40	0.40	0.35	0.35	0.386	
Med. user - 200 mins	0.30	0.30	0.30	0.30	0.30	0.34	0.34	0.311	
Large user - 500 mins	0.30	0.25	0.25	0.25	0.25	0.30	0.30	0.271	
Retail price plans	5	6	6	6	6	6	6		
Special features (chg.)	3	7	7	3	3	3	3		
Special features (free)	0	0	0	4	4	4	4		
BUFFALO-NWL Firm 6/1/84									
Small user - 0-50 mins	0.32	0.32	0.32	0.32	0.32	0.42	0.42	0.349	0.367
Med. user - 200 mins	0.32	0.30	0.30	0.30	0.32	0.34	0.34	0.317	0.314
Large user - 500 mins	0.32	0.27	0.27	0.27	0.32	0.34	0.34	0.304	0.288
Retail price plans	2	4	5	5	7	7	9		
Special features (chg.)	1	6	7	8	8	5	5		
Special features (free)	1	1	1	1	1	4	4		

Market/Date on line	Jan. 1985	Jan. 1986	Jan. 1987	Jan. 1988	Jan. 1989	Jan. 1990	Jan. 1991	Mean of Firm Prices	Mean of Mkt. Prices
CHICAGO-WL Firm 10/3/83									
Small user - 0-50 mins	0.80	0.60	0.60	0.65	0.65	0.65	0.38	0.619	
Med. user - 200 mins	0.38	0.38	0.38	0.38	0.35	0.35	0.34	0.366	
Large user - 500 mins	0.38	0.38	0.38	0.38	0.30	0.30	0.30	0.346	
Retail price plans	3	3	3	4	9	9	9		
Special features (chg.)	4	5	5	6	6	7	9		
Special features (free)	1	1	4	4	4	4	5		
CHICAGO-NWL Firm 1/7/85									
Small user - 0-50 mins	0.70	0.70	0.70	0.70	0.65	0.65	0.65	0.679	0.649
Med. user - 200 mins	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.320	0.343
Large user - 500 mins	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.270	0.308
Retail price plans	5	5	5	5	6	6	7		
Special features (chg.)	5	5	5	6	5	6	6		
Special features (free)	2	2	2	2	2	3	3		
CINCINNATI-WL Firm 11/5/85									
Small user - 0-50 mins		0.60	0.60	0.60	0.65	0.60	0.60	0.608	
Med. user - 200 mins		0.35	0.35	0.35	0.35	0.34	0.34	0.347	
Large user - 500 mins		0.25	0.25	0.25	0.25	0.32	0.32	0.273	
Retail price plans		4	4	6	6	7	10		
Special features (chg.)		5	5	7	7	7	7		
Special features (free)		1	4	6	6	7	7		
CINCINNATI-NWL Firm 8/8/86									
Small user - 0-50 mins			0.55	0.55	0.55	0.60	0.60	0.570	0.589
Med. user - 200 mins			0.35	0.35	0.35	0.34	0.34	0.346	0.346
Large user - 500 mins			0.25	0.25	0.25	0.33	0.33	0.282	0.278
Retail price plans			3	3	3	5	5		
Special features (chg.)			5	5	6	5	5		
Special features (free)			0	0	0	1	1		

Market/Date on line	Jan. 1985	Jan. 1986	Jan. 1987	Jan. 1988	Jan. 1989	Jan. 1990	Jan. 1991	Mean of Firm Prices	Mean of Mkt. Prices
CLEVELAND-WL Firm 12/18/84									
Small user - 0-50 mins	0.60	0.55	0.55	0.55	0.55	0.55	0.55	0.557	
Med. user - 200 mins	0.39	0.36	0.36	0.36	0.36	0.36	0.36	0.364	
Large user - 500 mins	0.39	0.33	0.33	0.33	0.33	0.29	0.29	0.327	
Retail price plans	2	2	2	2	2	4	4		
Special features (chg.)	4	4	5	5	5	5	5		
Special features (free)	0	0	3	3	3	4	4		
CLEVELAND-NWL Firm 6/1/85									
Small user - 0-50 mins		0.55	0.55	0.55	0.55	0.60	0.60	0.567	0.562
Med. user - 200 mins		0.35	0.35	0.35	0.35	0.34	0.34	0.347	0.355
Large user - 500 mins		0.35	0.35	0.35	0.35	0.33	0.33	0.343	0.335
Retail price plans		2	2	2	2	5	5		
Special features		5	5	6	5	5	5		
		3	3	4	4	1	1		
DALLAS-WL Firm 7/31/84									
Small user - 0-50 mins	0.38	0.38	0.60	0.60	0.60	0.60	0.60	0.537	
Med. user - 200 mins	0.38	0.38	0.38	0.38	0.35	0.35	0.35	0.367	
Large user - 500 mins	0.38	0.38	0.34	0.34	0.30	0.30	0.30	0.334	
Retail price plans	1	1	3	3	3	3	4		
Special features (chg.)	0	3	7	7	7	8	8		
Special features (free)	0	0	0	1	1	1	1		
DALLAS-NWL Firm 3/2/86									
Small user - 0-50 mins			0.60	0.60	0.60	0.60	0.49	0.578	0.558
Med. user - 200 mins			0.38	0.38	0.342	0.342	0.38	0.365	0.366
Large user - 500 mins			0.34	0.34	0.30	0.312	0.30	0.318	0.326
Retail price plans			3	3	3	7	8		
Special features (chg.)			4	5	5	5	5		
Special features (free)			5	5	5	5	5		

Market/Date on line	Jan. 1985	Jan. 1986	Jan. 1987	Jan. 1988	Jan. 1989	Jan. 1990	Jan. 1991	Mean of Firm Prices	Mean of Mkt. Prices
DENVER-WL Firm 7/10/84									
Small user - 0-50 mins	0.60	0.60	0.60	0.60	0.56	0.56	0.56	0.583	
Med. user - 200 mins	0.40	0.40	0.38	0.38	0.39	0.43	0.43	0.401	
Large user - 500 mins	0.39	0.36	0.36	0.36	0.36	0.37	0.37	0.367	
Retail price plans	4	5	5	5	5	2	2		
Special features (chg.)	3	3	2	2	2	2	2		
Special features (free)	2	2	5	9	9	9	9		
DENVER-NWL Firm 11/21/86									
Small user - 0-50 mins			0.70	0.70	0.70	0.70	0.70	0.700	0.641
Med. user - 200 mins			0.38	0.38	0.38	0.36	0.34	0.368	0.385
Large user - 500 mins			0.35	0.35	0.27	0.30	0.31	0.316	0.342
Retail price plans			6	6	3	2	8		
Special features (chg.)			4	5	5	8	8		
Special features (free)			4	4	4	1	1		
DETROIT-WL Firm 9/12/84									
Small user - 0-50 mins	0.80	0.80	0.60	0.60	0.56	0.65	0.60	0.659	
Med. user - 200 mins	0.35	0.35	0.35	0.35	0.33	0.33	0.33	0.341	
Large user - 500 mins	0.30	0.30	0.33	0.28	0.27	0.27	0.27	0.289	
Retail price plans	4	4	3	4	7	8	11		
Special features (chg.)	4	4	5	6	7	8	8		
Special features (free)	0	1	4	5	5	5	5		
DETROIT-NWL Firm 8/1/85									
Small user - 0-50 mins		0.80	0.80	0.80	0.35	0.55	0.55	0.642	0.650
Med. user - 200 mins		0.29	0.29	0.29	0.29	0.33	0.33	0.303	0.322
Large user - 500 mins		0.23	0.23	0.23	0.23	0.27	0.24	0.238	0.263
Retail price plans		4	4	4	3	6	6		
Special features (chg.)		5	10	8	11	11	11		
Special features (free)		0	0	3	0	0	0		

Market/Date on line	Jan. 1985	Jan. 1986	Jan. 1987	Jan. 1988	Jan. 1989	Jan. 1990	Jan. 1991	Mean of Firm Prices	Mean of Mkt. Prices
HOUSTON-WL Firm 9/28/84									
Small user - 0-50 mins	0.60	0.60	0.60	0.48	0.48	0.48	0.48	0.531	
Med. user - 200 mins	0.39	0.39	0.39	0.312	0.312	0.312	0.312	0.345	
Large user - 500 mins	0.39	0.39	0.39	0.312	0.312	0.312	0.312	0.345	
Retail price plans	2	2	2	6	6	6	6		
Special features (chg.)	3	5	6	5	5	5	5		
Special features (free)	1	1	4	4	4	4	4		
HOUSTON-NWL Firm 5/16/86									
Small user - 0-50 mins			0.60	0.60	0.60	0.60	0.6	0.600	0.566
Med. user - 200 mins			0.40	0.40	0.40	0.40	0.40	0.400	0.373
Large user - 500 mins			0.39	0.39	0.39	0.39	0.39	0.390	0.368
Retail price plans			3	3	3	3	3		
Special features (chg.)			5	5	5	5	5		
Special features (free)			1	1	1	1	1		
INDIANAPOLIS-WL Firm 5/3/84									
Small user - 0-50 mins	0.50	0.50	0.50	0.45	0.45	0.45	0.45	0.471	
Med. user - 200 mins	0.33	0.33	0.33	0.30	0.30	0.30	0.30	0.313	
Large user - 500 mins	0.33	0.33	0.33	0.24	0.24	0.24	0.24	0.279	
Retail price plans	3	3	3	5	5	5	5		
Special features (chg.)	4	4	5	5	5	5	5		
Special features (free)	0	0	3	3	3	3	3		
INDIANAPOLIS-NWL Firm 2/3/84									
Small user - 0-50 mins	0.75	0.50	0.50	0.50	0.50	0.50	0.32	0.510	0.491
Med. user - 200 mins	0.27	0.27	0.27	0.33	0.33	0.30	0.24	0.287	0.300
Large user - 500 mins	0.27	0.27	0.27	0.25	0.25	0.24	0.22	0.253	0.266
Retail price plans	7	7	7	5	5	5	4		
Special features (chg.)	1	1	1	2	2	5	6		
Special features (free)	0	0	0	2	2	2	2		

Market/Date on line	Jan. 1985	Jan. 1986	Jan. 1987	Jan. 1988	Jan. 1989	Jan. 1990	Jan. 1991	Mean of Firm Prices	Mean of Mkt. Prices
KANSAS CITY-WL Firm 8/14/84									
Small user - 0-50 mins	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.550	
Med. user - 200 mins	0.32	0.32	0.32	0.32	0.32	0.30	0.35	0.321	
Large user - 500 mins	0.27	0.26	0.27	0.27	0.27	0.26	0.35	0.279	
Retail price plans	3	3	3	3	6	8	3		
Special features (chg.)	3	3	4	6	6	6	6		
Special features (free)	1	1	1	2	2	2	2		
KANSAS CITY-NWL Firm 2/14/86									
Small user - 0-50 mins			0.55	0.55	0.55	0.55	0.55	0.550	0.550
Med. user - 200 mins			0.32	0.31	0.31	0.27	0.27	0.296	0.309
Large user - 500 mins			0.27	0.20	0.20	0.24	0.24	0.230	0.254
Retail price plans			3	5	5	8	8		
Special features (chg.)			7	7	7	7	7		
Special features (free)			0	0	0	0	0		
LOS ANGELES-WL Firm 6/13/84									
Small user - 0-50 mins	0.45	0.90	0.90	0.90	0.99	0.99	0.99	0.874	
Med. user - 200 mins	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.450	
Large user - 500 mins	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.450	
Retail price plans	1	7	7	8	9	9	11		
Special features (chg.)	0	2	2	6	6	6	6		
Special features (free)	1	3	3	3	3	3	3		
LOS ANGELES-NWL Firm 3/27/87									
Small user - 0-50 mins				0.90	0.90	0.90	0.9	0.900	0.887
Med. user - 200 mins				0.45	0.45	0.45	0.45	0.450	0.450
Large user - 500 mins				0.45	0.45	0.45	0.45	0.450	0.450
Retail price plans				7	7	7	7		
Special features (chg.)				6	6	7	7		
Special features (free)				3	3	3	3		

[illegible]

Market/Date on line	Jan. 1985	Jan. 1986	Jan. 1987	Jan. 1988	Jan. 1989	Jan. 1990	Jan. 1991	Mean of Firm Prices	Mean of Mkt. Prices
MINNEAPOLIS-WL Firm									
Small user - 0-50 mins	0.60	0.60	0.60	0.60	0.60	0.45	0.42	0.553	
Med. user - 200 mins	0.40	0.40	0.38	0.38	0.38	0.39	0.38	0.387	
Large user - 500 mins	0.40	0.36	0.36	0.36	0.36	0.38	0.36	0.369	
Retail price plans	3	4	4	4	4	2	4		
Special features (chg.)	4	4	5	5	5	2	2		
Special features (free)	0	0	5	5	5	9	9		
MINNEAPOLIS-NWL Firm 7/23/84									
Small user - 0-50 mins	0.53	0.53	0.65	0.65	0.60	0.55	0.43	0.563	0.558
Med. user - 200 mins	0.33	0.33	0.35	0.38	0.38	0.35	0.35	0.353	0.370
Large user - 500 mins	0.30	0.30	0.32	0.32	0.32	0.32	0.30	0.311	0.340
Retail price plans	4	3	5	6	4	4	6		
Special features (chg.)	0	0	4	4	4	4	5		
Special features (free)	8	8	4	4	4	4	5		
NEW ORLEANS-WL Firm 9/1/84									
Small user - 0-50 mins	0.42	0.35	0.35	0.35	0.35	0.35	0.35	0.360	
Med. user - 200 mins	0.39	0.35	0.35	0.35	0.35	0.35	0.35	0.356	
Large user - 500 mins	0.36	0.32	0.32	0.32	0.30	0.30	0.30	0.317	
Retail price plans	1	2	2	4	4	5	5		
Special features (chg.)	4	4	4	4	8	9	9		
Special features (free)	1	1	5	5	2	2	2		
NEW ORLEANS-NWL Firm 9/8/85									
Small user - 0-50 mins		0.33	0.33	0.33	0.33	0.33	0.33	0.330	0.345
Med. user - 200 mins		0.33	0.33	0.33	0.33	0.33	0.33	0.330	0.343
Large user - 500 mins		0.31	0.31	0.31	0.31	0.30	0.30	0.307	0.312
Retail price plans		1	1	1	1	5	5		
Special features (chg.)		4	0	3	3	7	7		
Special features (free)		1	4	4	4	1	1		

Market/Date on line	Jan. 1985	Jan. 1986	Jan. 1987	Jan. 1988	Jan. 1989	Jan. 1990	Jan. 1991	Mean of Firm Prices	Mean of Mkt. Prices
NEW YORK-WL Firm 6/15/84									
Small user - 0-50 mins	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.900	
Med. user - 200 mins	0.65	0.65	0.65	0.45	0.45	0.45	0.45	0.536	
Large user - 500 mins	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.400	
Retail price plans	5	6	6	3	3	3	3		
Special features (chg.)	2	4	7	4	4	5	5		
Special features (free)	1	1	2	5	5	5	5		
NEW YORK-NWL Firm 4/5/86									
Small user - 0-50 mins			0.75	0.75	0.75	0.80	0.80	0.770	0.835
Med. user - 200 mins			0.40	0.40	0.40	0.40	0.40	0.400	0.468
Large user - 500 mins			0.40	0.40	0.40	0.40	0.40	0.400	0.400
Retail price plans			3	3	3	3	3		
Special features (chg.)			6	3	3	3	3		
Special features (free)			3	7	7	7	7		
PHILADELPHIA-WL Firm 7/12/84									
Small user - 0-50 mins	0.45	0.65	0.65	0.65	0.65	0.65	0.75	0.636	
Med. user - 200 mins	0.45	0.45	0.45	0.50	0.50	0.50	0.50	0.479	
Large user - 500 mins	0.45	0.45	0.45	0.45	0.45	0.45	0.40	0.443	
Retail price plans	5	4	4	5	5	5	6		
Special features (chg.)	0	0	0	3	3	4	4		
Special features (free)	5	6	6	6	6	6	6		
PHILADELPHIA-NWL Firm 2/12/86									
Small user - 0-50 mins			0.65	0.65	0.65	0.65	0.74	0.668	0.652
Med. user - 200 mins			0.50	0.50	0.50	0.50	0.50	0.500	0.489
Large user - 500 mins			0.45	0.45	0.45	0.45	0.45	0.450	0.446
Retail price plans			3	3	4	4	10		
Special features (chg.)			0	4	4	4	4		
Special features (free)			5	5	5	5	5		

Market/Date on line	Jan. 1985	Jan. 1986	Jan. 1987	Jan. 1988	Jan. 1989	Jan. 1990	Jan. 1991	Mean of Firm Prices	Mean of Mkt. Prices
PHOENIX-WL Firm 8/15/84									
Small user - 0-50 mins	0.60	0.60	0.60	0.60	0.60	0.38	0.45	0.547	
Med. user - 200 mins	0.40	0.40	0.38	0.38	0.38	0.38	0.45	0.396	
Large user - 500 mins	0.39	0.36	0.36	0.36	0.36	0.37	0.44	0.377	
Retail price plans	4	5	5	6	6	2	2		
Special features (chg.)	3	3	5	5	5	6	6		
Special features (free)	2	2	1	6	6	5	5		
PHOENIX-NWL Firm 3/7/86									
Small user - 0-50 mins			0.55	0.55	0.55	0.35	0.40	0.480	0.514
Med. user - 200 mins			0.35	0.35	0.35	0.35	0.35	0.350	0.373
Large user - 500 mins			0.34	0.36	0.36	0.34	0.34	0.348	0.363
Retail price plans			2	4	4	2	4		
Special features (chg.)			4	1	0	0	0		
Special features (free)			3	8	9	10	10		
PITTSBURGH-WL Firm 12/10/84									
Small user - 0-50 mins	0.49	0.65	0.65	0.65	0.65	0.65	0.75	0.641	
Med. user - 200 mins	0.49	0.49	0.49	0.47	0.47	0.47	0.37	0.464	
Large user - 500 mins	0.49	0.49	0.49	0.47	0.47	0.47	0.37	0.464	
Retail price plans	3	3	3	5	5	5	3		
Special features (chg.)	0	0	4	4	4	4	4		
Special features (free)	5	5	6	6	6	6	6		
PITTSBURGH-NWL Firm 12/19/86									
Small user - 0-50 mins			NA	0.65	0.65	0.65	0.65	0.650	0.646
Med. user - 200 mins			NA	0.47	0.47	0.47	0.38	0.448	0.456
Large user - 500 mins			NA	0.47	0.47	0.47	0.38	0.448	0.456
Retail price plans			NA	3	5	5	4		
Special features (chg.)			NA	4	4	4	4		
Special features (free)			NA	6	6	7	7		

Market/Date on line	Jan. 1985	Jan. 1986	Jan. 1987	Jan. 1988	Jan. 1989	Jan. 1990	Jan. 1991	Mean of Firm Prices	Mean of Mkt. Prices
PORTLAND-WL Firm 2/27/85									
Small user - 0-50 mins		0.38	0.38	0.35	0.35	0.35	0.35	0.360	
Med. user - 200 mins		0.38	0.38	0.38	0.35	0.35	0.35	0.365	
Large user - 500 mins		0.38	0.38	0.34	0.34	0.34	0.34	0.353	
Retail price plans		2	1	3	3	4	4		
Special features (chg.)		0	1	2	2	2	2		
Special features (free)		1	7	7	7	7	7		
PORTLAND-NWL Firm 7/18/85									
Small user - 0-50 mins		0.68	0.68	0.38	0.38	0.38	0.33	0.472	0.416
Med. user - 200 mins		0.38	0.38	0.35	0.35	0.35	0.29	0.350	0.358
Large user - 500 mins		0.38	0.38	0.35	0.35	0.35	0.25	0.343	0.348
Retail price plans		4	4	6	6	6	7		
Special features (chg.)		4	8	9	9	9	9		
Special features (free)		0	0	0	0	0	0		
ST. LOUIS-WL Firm 7/16/84									
Small user - 0-50 mins	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.500	
Med. user - 200 mins	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.340	
Large user - 500 mins	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.280	
Retail price plans	3	3	3	5	5	5	5		
Special features (chg.)	4	4	8	8	8	9	9		
Special features (free)	0	0	0	1	1	1	1		
ST. LOUIS-NWL Firm 7/16/84									
Small user - 0-50 mins	0.60	0.44	0.50	0.50	0.50	0.50	0.50	0.506	0.503
Med. user - 200 mins	0.34	0.34	0.34	0.34	0.34	0.34	0.28	0.331	0.336
Large user - 500 mins	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.280	0.280
Retail price plans	3	9	6	6	6	6	5		
Special features (chg.)	3	3	8	8	8	6	6		
Special features (free)	1	1	1	1	1	3	3		

Market/Date on line	Jan. 1985	Jan. 1986	Jan. 1987	Jan. 1988	Jan. 1989	Jan. 1990	Jan. 1991	Mean of Firm Prices	Mean of Mkt. Prices
SAN DIEGO-WL Firm 8/13/85									
Small user - 0-50 mins		0.40	0.40	0.74	0.74	0.74	0.74	0.627	
Med. user - 200 mins		0.40	0.40	0.40	0.40	0.40	0.40	0.400	
Large user - 500 mins		0.40	0.40	0.36	0.36	0.40	0.36	0.380	
Retail price plans		1	1	5	5	4	5		
Special features (chg.)		0	0	6	6	6	6		
Special features (free)		0	0	2	2	2	2		
SAN DIEGO-NWL Firm 4/11/86									
Small user - 0-50 mins			0.40	0.40	0.40	0.40	0.40	0.400	0.513
Med. user - 200 mins			0.40	0.35	0.35	0.35	0.35	0.360	0.380
Large user - 500 mins			0.40	0.35	0.35	0.35	0.35	0.360	0.370
Retail price plans			1	1	1	1	2		
Special features (chg.)			2	2	2	2	2		
Special features (free)			5	5	5	5	5		
SAN FRAN-S'JOSE WL Firm 4/2/85									
Small user - 0-50 mins		0.45	0.45	0.45	0.90	0.90	0.90	0.675	
Med. user - 200 mins		0.45	0.45	0.45	0.45	0.45	0.45	0.450	
Large user - 500 mins		0.45	0.45	0.45	0.45	0.45	0.45	0.450	
Retail price plans		1	1	1	2	4	4		
Special features (chg.)		0	0	6	6	6	5		
Special features (free)		0	4	4	4	4	4		
S'FRAN-S'JOSE-NWL Firm 9/26/86									
Small user - 0-50 mins			0.45	0.45	0.90	0.90	0.90	0.720	0.698
Med. user - 200 mins			0.45	0.45	0.45	0.45	0.45	0.450	0.450
Large user - 500 mins			0.45	0.45	0.45	0.45	0.45	0.450	0.450
Retail price plans			1	1	2	2	3		
Special features (chg.)			4	5	5	6	5		
Special features (free)			4	4	4	4	4		

Market/Date on line	Jan. 1985	Jan. 1986	Jan. 1987	Jan. 1988	Jan. 1989	Jan. 1990	Jan. 1991	Mean of Firm Prices	Mean of Mkt. Prices
SEATTLE-WL Firm 7/2/84									
Small user - 0-50 mins	0.60	0.60	0.56	0.56	0.56	0.49	0.54	0.559	
Med. user - 200 mins	0.40	0.40	0.36	0.38	0.38	0.44	0.45	0.401	
Large user - 500 mins	0.40	0.36	0.31	0.31	0.31	0.42	0.44	0.364	
Retail price plans	4	5	4	6	5	2	3		
Special features (chg.)	3	3	4	5	1	1	2		
Special features (free)	2	2	5	5	9	9	9		
SEATTLE-NWL Firm 12/12/85									
Small user - 0-50 mins		0.70	0.70	0.70	0.70	0.57	0.57	0.657	0.608
Med. user - 200 mins		0.35	0.35	0.38	0.38	0.45	0.45	0.393	0.397
Large user - 500 mins		0.30	0.30	0.30	0.30	0.33	0.33	0.310	0.337
Retail price plans		5	5	7	7	5	5		
Special features (chg.)		7	7	5	5	5	2		
Special features (free)		0	0	3	3	3	6		
TAMPA-WL Firm 11/30/84									
Small user - 0-50 mins	0.60	0.60	0.60	0.54	0.60	0.60	0.60	0.591	
Med. user - 200 mins	0.39	0.39	0.39	0.35	0.35	0.35	0.35	0.367	
Large user - 500 mins	0.39	0.39	0.39	0.35	0.35	0.35	0.35	0.367	
Retail price plans	2	2	2	3	4	9	9		
Special features (chg.)	0	0	1	5	3	3	3		
Special features (free)	0	0	3	3	5	5	5		
TAMPA-NWL Firm 9/25/87									
Small user - 0-50 mins				0.49	0.49	0.49	0.51	0.495	0.543
Med. user - 200 mins				0.38	0.35	0.35	0.38	0.365	0.366
Large user - 500 mins				0.35	0.35	0.35	0.35	0.350	0.359
Retail price plans				2	3	4	3		
Special features (chg.)				6	6	6	7		
Special features (free)				4	4	4	3		
Mean - Small user	0.575	0.562	0.569	0.569	0.579	0.566	0.554	0.568	0.570
Mean - Med. user	0.378	0.371	0.374	0.369	0.365	0.367	0.366	0.370	0.370
Mean - Large user	0.355	0.336	0.340	0.334	0.328	0.337	0.333	0.338	0.338
Mean No. Price Plans/Mkt	4.417	5.679	6.852	8.786	9.286	9.821	10.929		7.967

Data source: A History of Cellular Telephone Pricing, 1985-1991

APPENDIX B

PRICE PERFORMANCE INDEX (PPI)

Annual price change, adjusted for change in Consumer Price Index (sign reversed)

		1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	Mean PPI for Firm
ATLANTA - WL Firm								
Small user - 0-50 mins	0.40	0.35	0.35	0.35	0.35	0.35	0.35	
% change in price in period		-12.50	0.00	0.00	0.00	0.00	0.00	
% change in CPI		3.60	1.90	3.60	4.10	4.80	5.40	
PPI (CPI change - price change * 100)		16.10	1.90	3.60	4.10	4.80	5.40	5.98
Med. user - 200 mins								
% change in price in period	0.25	0.25	0.00	0.00	0.00	0.00	0.00	
% change in CPI		3.60	1.90	3.60	4.10	4.80	5.40	
PPI (CPI change - price change * 100)		3.60	1.90	3.60	4.10	4.80	5.40	3.90
Large user - 500 mins								
% change in price in period	0.37	0.25	0.00	0.00	0.00	0.00	0.00	
% change in CPI		3.60	1.90	3.60	4.10	4.80	5.40	
PPI (CPI change - price change * 100)		36.03	1.90	3.60	4.10	4.80	5.40	9.31
Mean PPI for firm		18.58	1.90	3.60	4.10	4.80	5.40	6.40
ATLANTA - NWL Firm								
Small user - 0-50 mins				0.35	0.35	0.35	0.35	
% change in price in period				0.00	0.00	0.00	0.00	
% change in CPI				4.10	4.80	5.40		
PPI (CPI change - price change * 100)				4.10	4.80	5.40		4.77
Med. user - 200 mins								
% change in price in period			0.25	0.25	0.25	0.25		
% change in CPI				0.00	0.00	0.00		
PPI (CPI change - price change * 100)				4.10	4.80	5.40		4.77
Large user - 500 mins								
% change in price in period			0.25	0.25	0.25	0.25		
% change in CPI				4.10	4.80	5.40		
PPI (CPI change - price change * 100)				4.10	4.80	5.40		4.77
Mean PPI for firm				4.10	4.80	5.40		4.77
BALT-WASH - WL Firm								
Small user - 0-50 mins	0.45	0.65	0.65	0.65	0.65	0.65	0.65	
PPI (CPI change - price change * 100)		-40.84	1.90	3.60	4.10	4.80	5.40	-3.51
Med. user - 200 mins								
PPI (CPI change - price change * 100)	0.36	0.36	0.36	0.36	0.39	0.36	0.36	
		3.60	1.90	3.60	-4.23	12.49	5.40	3.79

	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	Mean PPI for Firm
Large user - 500 mins	0.36	0.36	0.36	0.36	0.36	0.36	
PPI (CPI change - price change * 100)	3.60	1.90	3.60	4.10	4.80	5.40	3.90
Mean PPI for firm	-11.21	1.90	3.60	1.32	7.36	5.40	1.40
BALT-WASH - NWL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)	23.60	1.90	3.60	4.10	4.80	40.40	13.07
Med. user - 200 mins							
PPI (CPI change - price change * 100)	3.60	1.90	3.60	4.10	4.80	-17.10	0.15
Large user - 500 mins							
PPI (CPI change - price change * 100)	13.60	1.90	3.60	4.10	-6.31	7.90	4.13
Mean PPI for firm	13.60	1.90	3.60	4.10	1.10	10.40	5.78
BOSTON - WL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)	3.60	1.90	3.60	4.10	4.80	25.40	7.23
Med. user - 200 mins							
PPI (CPI change - price change * 100)	3.60	1.90	3.60	4.10	4.80	-10.16	1.31
Large user - 500 mins							
PPI (CPI change - price change * 100)	3.60	1.90	3.60	4.10	4.80	-14.60	0.57
Mean PPI for firm	3.60	1.90	3.60	4.10	4.80	0.21	3.04
BOSTON - NWL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)	3.60	1.90	3.60	4.10	44.80	7.62	10.94
Med. user - 200 mins							
PPI (CPI change - price change * 100)	8.15	1.90	3.60	4.10	4.80	5.40	4.66
Large user - 500 mins							
PPI (CPI change - price change * 100)	24.05	1.90	3.60	4.10	4.80	5.40	7.31
Mean PPI for firm	11.93	1.90	3.60	4.10	18.13	6.14	7.63

	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	Mean PPI for Firm
BUFFALO - WL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)	3.60	1.90	3.60	4.10	17.30	5.40	5.98
Med. user - 200 mins							
PPI (CPI change - price change * 100)	3.60	1.90	3.60	4.10	-8.53	5.40	1.68
Large user - 500 mins							
PPI (CPI change - price change * 100)	20.27	1.90	3.60	4.10	-15.20	5.40	3.34
Mean PPI for firm	9.16	1.90	3.60	4.10	-2.14	5.40	3.67
BUFFALO -NWL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)	3.60	1.90	3.60	4.10	-26.45	5.40	-1.31
Med. user - 200 mins							
PPI (CPI change - price change * 100)	9.85	1.90	3.60	-2.57	-1.45	5.40	2.79
Large user - 500 mins							
PPI (CPI change - price change * 100)	19.23	1.90	3.60	-14.42	-1.45	5.40	2.38
Mean PPI for firm	10.89	1.90	3.60	-4.30	-9.78	5.40	1.29
CHICAGO - WL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)	28.60	1.90	-4.73	4.10	4.80	46.94	13.60
Med. user - 200 mins							
PPI (CPI change - price change * 100)	3.60	1.90	3.60	11.99	4.80	8.26	5.69
Large user - 500 mins							
PPI (CPI change - price change * 100)	3.60	1.90	3.60	25.15	4.80	5.40	7.41
Mean PPI for firm	11.93	1.90	0.82	13.75	4.80	20.20	8.90
CHICAGO -NWL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)	3.60	1.90	3.60	11.24	4.80	5.40	5.09
Med. user - 200 mins							
PPI (CPI change - price change * 100)	3.60	1.90	3.60	4.10	4.80	5.40	3.90
Large user - 500 mins							
PPI (CPI change - price change * 100)	3.60	1.90	3.60	4.10	4.80	5.40	3.90
Mean PPI for firm	3.60	1.90	3.60	6.48	4.80	5.40	4.30

	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	Mean PPI for Firm
CINCINNATI - WL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)		1.90	3.60	-4.23	12.49	5.40	3.83
Med. user - 200 mins							
PPI (CPI change - price change * 100)		1.90	3.60	4.10	7.66	5.40	4.53
Large user - 500 mins							
PPI (CPI change - price change * 100)		1.90	3.60	4.10	-23.20	5.40	-1.64
Mean PPI for firm		1.90	3.60	1.32	-1.02	5.40	2.24
CINCINNATI -NWL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)			3.60	4.10	-4.29	5.40	2.20
Med. user - 200 mins							
PPI (CPI change - price change * 100)			3.60	4.10	7.66	5.40	5.19
Large user - 500 mins							
PPI (CPI change - price change * 100)			3.60	4.10	-27.20	5.40	-3.53
Mean PPI for firm			3.60	4.10	-7.94	5.40	1.29
CLEVELAND - WL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)	11.93	1.90	3.60	4.10	4.80	5.40	5.29
Med. user - 200 mins							
PPI (CPI change - price change * 100)	11.29	1.90	3.60	4.10	4.80	5.40	5.18
Large user - 500 mins							
PPI (CPI change - price change * 100)	18.98	1.90	3.60	4.10	16.92	5.40	8.48
Mean PPI for firm	14.07	1.90	3.60	4.10	8.84	5.40	6.32
CLEVELAND -NWL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)		1.90	3.60	4.10	-4.29	5.40	2.14
Med. user - 200 mins							
PPI (CPI change - price change * 100)		1.90	3.60	4.10	7.66	5.40	4.53
Large user - 500 mins							
PPI (CPI change - price change * 100)		1.90	3.60	4.10	10.51	5.40	5.10
Mean PPI for firm		1.90	3.60	4.10	4.63	5.40	3.93

	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	Mean PPI for Firm
DALLAS - WL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)	3.60	-55.99	3.60	4.10	4.80	5.40	-5.75
Med. user - 200 mins							
PPI (CPI change - price change * 100)	3.60	1.90	3.60	11.99	4.80	5.40	5.22
Large user - 500 mins							
PPI (CPI change - price change * 100)	3.60	12.43	3.60	15.86	4.80	5.40	7.62
Mean PPI for firm	3.60	-13.89	3.60	10.65	4.80	5.40	2.36
DALLAS - NWL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)			3.60	4.10	4.80	23.73	9.06
Med. user - 200 mins							
PPI (CPI change - price change * 100)			3.60	14.10	4.80	-5.71	4.20
Large user - 500 mins							
PPI (CPI change - price change * 100)			3.60	15.86	0.80	9.25	7.38
Mean PPI for firm			3.60	11.35	3.47	9.09	6.88
DENVER - WL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)	3.60	1.90	3.60	10.77	4.80	5.40	5.01
Med. user - 200 mins							
PPI (CPI change - price change * 100)	3.60	6.90	3.60	1.47	-5.46	5.40	2.59
Large user - 500 mins							
PPI (CPI change - price change * 100)	11.29	1.90	3.60	4.10	2.02	5.40	4.72
Mean PPI for firm	6.16	3.57	3.60	5.45	0.46	5.40	4.11
DENVER - NWL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)			3.60	4.10	4.80	5.40	4.48
Med. user - 200 mins							
PPI (CPI change - price change * 100)			3.60	4.10	10.06	10.96	7.18
Large user - 500 mins							
PPI (CPI change - price change * 100)			3.60	26.96	-6.31	2.07	6.58
Mean PPI for firm			3.60	11.72	2.85	6.14	6.08

	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	Mean PPI for Firm
DETROIT - WL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)	3.60	26.90	3.60	10.77	-11.27	13.09	7.78
Med. user - 200 mins							
PPI (CPI change - price change * 100)	3.60	1.90	3.60	9.81	4.80	5.40	4.85
Large user - 500 mins							
PPI (CPI change - price change * 100)	3.60	-8.10	18.75	7.67	4.80	5.40	5.35
Mean PPI for firm	3.60	6.90	8.65	9.42	-0.56	7.96	6.00
DETROIT - NWL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)		1.90	3.60	60.35	-52.34	5.40	3.78
Med. user - 200 mins							
PPI (CPI change - price change * 100)		1.90	3.60	4.10	-8.99	5.40	1.20
Large user - 500 mins							
PPI (CPI change - price change * 100)		1.90	3.60	4.10	-12.59	16.51	2.70
Mean PPI for firm		1.90	3.60	22.85	-24.64	9.10	2.56
HOUSTON - WL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)	3.60	1.90	23.60	4.10	4.80	5.40	7.23
Med. user - 200 mins							
PPI (CPI change - price change * 100)	3.60	1.90	23.60	4.10	4.80	5.40	7.23
Large user - 500 mins							
PPI (CPI change - price change * 100)	3.60	1.90	23.60	4.10	4.80	5.40	7.23
Mean PPI for firm	3.60	1.90	23.60	4.10	4.80	5.40	7.23
HOUSTON - NWL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)			3.60	4.10	4.80	5.40	4.48
Med. user - 200 mins							
PPI (CPI change - price change * 100)			3.60	4.10	4.80	5.40	4.48
Large user - 500 mins							
PPI (CPI change - price change * 100)			3.60	4.10	4.80	5.40	4.48
Mean PPI for firm			3.60	4.10	4.80	5.40	4.48

	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	Mean PPI for Firm
INDIANAPOLIS - WL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)	3.60	1.90	13.60	4.10	4.80	5.40	5.57
Med. user - 200 mins							
PPI (CPI change - price change * 100)	3.60	1.90	12.69	4.10	4.80	5.40	5.42
Large user - 500 mins							
PPI (CPI change - price change * 100)	3.60	1.90	30.87	4.10	4.80	5.40	8.45
Mean PPI for firm	3.60	1.90	19.05	4.10	4.80	5.40	6.48
INDIANAPOLIS - NWL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)	36.93	1.90	3.60	4.10	4.80	41.40	15.46
Med. user - 200 mins							
PPI (CPI change - price change * 100)	3.60	1.90	-18.62	4.10	13.89	25.40	5.04
Large user - 500 mins							
PPI (CPI change - price change * 100)	3.60	1.90	11.01	4.10	8.80	13.73	7.19
Mean PPI for firm	14.71	1.90	-1.34	4.10	9.16	26.84	9.23
KANSAS CITY - WL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)	3.60	1.90	3.60	4.10	4.80	5.40	3.90
Med. user - 200 mins							
PPI (CPI change - price change * 100)	3.60	1.90	3.60	4.10	11.05	-11.27	2.16
Large user - 500 mins							
PPI (CPI change - price change * 100)	7.30	-1.95	3.60	4.10	8.50	-29.22	-1.28
Mean PPI for firm	4.83	0.62	3.60	4.10	8.12	-11.69	1.60
KANSAS CITY - NWL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)			3.60	4.10	4.80	5.40	4.48
Med. user - 200 mins							
PPI (CPI change - price change * 100)			6.73	4.10	17.70	5.40	8.48
Large user - 500 mins							
PPI (CPI change - price change * 100)			29.53	4.10	-15.20	5.40	5.96
Mean PPI for firm			13.28	4.10	2.43	5.40	6.30

	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	Mean PPI for Firm
LOS ANGELES - WL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)	-96.40	1.90	3.60	-5.90	4.80	5.40	-14.43
Med. user - 200 mins							
PPI (CPI change - price change * 100)	3.60	1.90	3.60	4.10	4.80	5.40	3.90
Large user - 500 mins							
PPI (CPI change - price change * 100)	3.60	1.90	3.60	4.10	4.80	5.40	3.90
Mean PPI for firm	-29.73	1.90	3.60	0.77	4.80	5.40	-2.21
LOS ANGELES - NWL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)				4.10	4.80	5.40	4.77
Med. user - 200 mins							
PPI (CPI change - price change * 100)				4.10	4.80	5.40	4.77
Large user - 500 mins							
PPI (CPI change - price change * 100)				4.10	4.80	5.40	4.77
Mean PPI for firm				4.10	4.80	5.40	4.77
MIAMI - WL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)	16.10	1.90	3.60	-10.19	7.30	5.40	4.02
Med. user - 200 mins							
PPI (CPI change - price change * 100)	16.10	1.90	3.60	-1.61	4.80	5.40	5.03
Large user - 500 mins							
PPI (CPI change - price change * 100)	31.10	12.24	-4.09	-10.19	4.80	14.78	8.11
Mean PPI for firm	21.10	5.35	1.04	-7.33	5.63	8.53	5.72
MIAMI - NWL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)				4.10	4.80	5.40	4.77
Med. user - 200 mins							
PPI (CPI change - price change * 100)				-11.53	4.80	-0.01	-2.24
Large user - 500 mins							
PPI (CPI change - price change * 100)				19.73	4.80	-9.41	5.04
Mean PPI for firm				4.10	4.80	-1.34	2.52

	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	Mean PPI for Firm
MILWAUKEE - WL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)	28.60	1.90	-4.73	4.10	4.80	5.40	6.68
Med. user - 200 mins							
PPI (CPI change - price change * 100)	-48.40	1.90	3.60	46.21	4.80	5.40	2.25
Large user - 500 mins							
PPI (CPI change - price change * 100)	-16.40	1.90	3.60	30.77	4.80	5.40	5.01
Mean PPI for firm	-12.07	1.90	0.82	27.02	4.80	5.40	4.65
MILWAUKEE - NWL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)	14.71	1.90	3.60	4.10	4.80	5.40	5.75
Med. user - 200 mins							
PPI (CPI change - price change * 100)	3.60	1.90	3.60	4.10	4.80	5.40	3.90
Large user - 500 mins							
PPI (CPI change - price change * 100)	3.60	1.90	3.60	4.10	4.80	5.40	3.90
Mean PPI for firm	7.30	1.90	3.60	4.10	4.80	5.40	4.52
MINNEAPOLIS - WL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)	3.60	1.90	3.60	4.10	29.80	12.07	9.18
Med. user - 200 mins							
PPI (CPI change - price change * 100)	3.60	6.90	3.60	4.10	2.17	7.96	4.72
Large user - 500 mins							
PPI (CPI change - price change * 100)	13.60	1.90	3.60	4.10	-0.76	10.66	5.52
Mean PPI for firm	6.93	3.57	3.60	4.10	10.40	10.23	6.47
MINNEAPOLIS - NWL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)	3.60	-20.74	3.60	11.79	13.13	27.22	6.43
Med. user - 200 mins							
PPI (CPI change - price change * 100)	3.60	-4.16	-4.97	4.10	12.69	5.40	2.78
Large user - 500 mins							
PPI (CPI change - price change * 100)	3.60	-4.77	3.60	4.10	4.80	11.65	3.83
Mean PPI for firm	3.60	-9.89	0.74	6.66	10.21	14.76	4.35

	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	Mean PPI for Firm
NEW ORLEANS - WL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)	20.27	1.90	3.60	4.10	4.80	5.40	6.68
Med. user - 200 mins							
PPI (CPI change - price change * 100)	13.86	1.90	3.60	4.10	4.80	5.40	5.61
Large user - 500 mins							
PPI (CPI change - price change * 100)	14.71	1.90	3.60	10.35	4.80	5.40	6.79
Mean PPI for firm	16.28	1.90	3.60	6.18	4.80	5.40	6.36
NEW ORLEANS - NWL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)		1.90	3.60	4.10	4.80	5.40	3.96
Med. user - 200 mins							
PPI (CPI change - price change * 100)		1.90	3.60	4.10	4.80	5.40	3.96
Large user - 500 mins							
PPI (CPI change - price change * 100)		1.90	3.60	4.10	8.03	5.40	4.61
Mean PPI for firm		1.90	3.60	4.10	5.88	5.40	4.18
NEW YORK - WL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)	3.60	1.90	3.60	4.10	4.80	5.40	3.90
Med. user - 200 mins							
PPI (CPI change - price change * 100)	3.60	1.90	34.37	4.10	4.80	5.40	9.03
Large user - 500 mins							
PPI (CPI change - price change * 100)	3.60	1.90	3.60	4.10	4.80	5.40	3.90
Mean PPI for firm	3.60	1.90	13.86	4.10	4.80	5.40	5.61
NEW YORK - NWL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)			3.60	4.10	-1.87	5.40	2.81
Med. user - 200 mins							
PPI (CPI change - price change * 100)			3.60	4.10	4.80	5.40	4.48
Large user - 500 mins							
PPI (CPI change - price change * 100)			3.60	4.10	4.80	5.40	4.48
Mean PPI for firm			3.60	4.10	2.58	5.40	3.92

	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	Mean PPI for Firm
PHILADELPHIA - WL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)	-40.84	1.90	3.60	4.10	4.80	-9.98	-6.07
Med. user - 200 mins							
PPI (CPI change - price change * 100)	3.60	1.90	-7.51	4.10	4.80	5.40	2.05
Large user - 500 mins							
PPI (CPI change - price change * 100)	3.60	1.90	3.60	4.10	4.80	16.51	5.75
Mean PPI for firm	-11.21	1.90	-0.10	4.10	4.80	3.98	0.58
PHILADELPHIA - NWL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)			3.60	4.10	4.80	-8.45	1.01
Med. user - 200 mins							
PPI (CPI change - price change * 100)			3.60	4.10	4.80	5.40	4.48
Large user - 500 mins							
PPI (CPI change - price change * 100)			3.60	4.10	4.80	5.40	4.48
Mean PPI for firm			3.60	4.10	4.80	0.78	3.32
PHOENIX - WL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)	3.60	1.90	3.60	4.10	41.47	-13.02	6.94
Med. user - 200 mins							
PPI (CPI change - price change * 100)	3.60	6.90	3.60	4.10	4.80	-13.02	1.66
Large user - 500 mins							
PPI (CPI change - price change * 100)	11.29	1.90	3.60	4.10	2.02	-13.52	1.57
Mean PPI for firm	6.16	3.57	3.60	4.10	16.10	-13.19	3.39
PHOENIX - NWL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)			3.60	4.10	41.16	-8.89	9.99
Med. user - 200 mins							
PPI (CPI change - price change * 100)			3.60	4.10	4.80	5.40	4.48
Large user - 500 mins							
PPI (CPI change - price change * 100)			-2.28	4.10	10.36	5.40	4.39
Mean PPI for firm			1.64	4.10	18.77	0.64	6.29

	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	Mean PPI for Firm
PITTSBURGH - WL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)	-29.05	1.90	3.60	4.10	4.80	-9.98	-4.11
Med. user - 200 mins							
PPI (CPI change - price change * 100)	3.60	1.90	7.68	4.10	4.80	26.68	8.13
Large user - 500 mins							
PPI (CPI change - price change * 100)	3.60	1.90	7.68	4.10	4.80	26.68	8.13
Mean PPI for firm	-7.28	1.90	6.32	4.10	4.80	14.46	4.05
PITTSBURGH - NWL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)				4.10	4.80	5.40	4.77
Med. user - 200 mins							
PPI (CPI change - price change * 100)				4.10	4.80	24.55	11.15
Large user - 500 mins							
PPI (CPI change - price change * 100)				4.10	4.80	24.55	11.15
Mean PPI for firm				4.10	4.80	18.17	9.02
PORTLAND - WL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)		1.90	11.49	4.10	4.80	5.40	5.54
Med. user - 200 mins							
PPI (CPI change - price change * 100)		1.90	3.60	11.99	4.80	5.40	5.54
Large user - 500 mins							
PPI (CPI change - price change * 100)		1.90	14.13	4.10	4.80	5.40	6.07
Mean PPI for firm		1.90	9.74	6.73	4.80	5.40	5.71
PORTLAND - NWL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)		1.90	47.72	4.10	4.80	18.56	15.42
Med. user - 200 mins							
PPI (CPI change - price change * 100)		1.90	11.49	4.10	4.80	22.54	8.97
Large user - 500 mins							
PPI (CPI change - price change * 100)		1.90	11.49	4.10	4.80	33.97	11.25
Mean PPI for firm		1.90	23.57	4.10	4.80	25.02	11.88

	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	Mean PPI for Firm
ST. LOUIS - WL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)	3.60	1.90	3.60	4.10	4.80	5.40	3.90
Med. user - 200 mins							
PPI (CPI change - price change * 100)	3.60	1.90	3.60	4.10	4.80	5.40	3.90
Large user - 500 mins							
PPI (CPI change - price change * 100)	3.60	1.90	3.60	4.10	4.80	5.40	3.90
Mean PPI for firm	3.60	1.90	3.60	4.10	4.80	5.40	3.90
ST. LOUIS - NWL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)	30.27	-11.74	3.60	4.10	4.80	5.40	6.07
Med. user - 200 mins							
PPI (CPI change - price change * 100)	3.60	1.90	3.60	4.10	4.80	23.05	6.84
Large user - 500 mins							
PPI (CPI change - price change * 100)	3.60	1.90	3.60	4.10	4.80	5.40	3.90
Mean PPI for firm	12.49	-2.65	3.60	4.10	4.80	11.28	5.60
SAN DIEGO - WL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)		1.90	-81.40	4.10	4.80	5.40	-13.04
Med. user - 200 mins							
PPI (CPI change - price change * 100)		1.90	3.60	4.10	4.80	5.40	3.96
Large user - 500 mins							
PPI (CPI change - price change * 100)		1.90	13.60	4.10	-6.31	15.40	5.74
Mean PPI for firm		1.90	-21.40	4.10	1.10	8.73	-1.11
SAN DIEGO - NWL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)			3.60	4.10	4.80	5.40	4.48
Med. user - 200 mins							
PPI (CPI change - price change * 100)			16.10	4.10	4.80	5.40	7.60
Large user - 500 mins							
PPI (CPI change - price change * 100)			16.10	4.10	4.80	5.40	7.60
Mean PPI for firm			11.93	4.10	4.80	5.40	6.56

	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	Mean PPI for Firm
SAN FRAN - SAN JOSE - WL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)		1.90	3.60	-95.90	4.80	5.40	-16.04
Med. user - 200 mins							
PPI (CPI change - price change * 100)		1.90	3.60	4.10	4.80	5.40	3.96
Large user - 500 mins							
PPI (CPI change - price change * 100)		1.90	3.60	4.10	4.80	5.40	3.96
Mean PPI for firm		1.90	3.60	-29.23	4.80	5.40	-2.71
SAN FRAN - SAN JOSE - NWL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)			3.60	-95.90	4.80	5.40	-16.42
Med. user - 200 mins							
PPI (CPI change - price change * 100)			3.60	4.10	4.80	5.40	3.58
Large user - 500 mins							
PPI (CPI change - price change * 100)			3.60	4.10	4.80	5.40	3.58
Mean PPI for firm			3.60	-29.23	4.80	5.40	-3.09
SEATTLE - WL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)	3.60	8.57	3.60	4.10	17.30	-4.80	5.39
Med. user - 200 mins							
PPI (CPI change - price change * 100)	3.60	11.90	-1.96	4.10	-10.99	3.13	1.63
Large user - 500 mins							
PPI (CPI change - price change * 100)	13.60	15.79	3.60	4.10	-30.68	0.64	1.17
Mean PPI for firm	6.93	12.09	1.75	4.10	-8.12	-0.35	2.73
SEATTLE - NWL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)		1.90	3.60	4.10	23.37	5.40	7.67
Med. user - 200 mins							
PPI (CPI change - price change * 100)		1.90	-4.97	4.10	-13.62	5.40	-1.44
Large user - 500 mins							
PPI (CPI change - price change * 100)		1.90	3.60	4.10	-5.20	5.40	1.96
Mean PPI for firm		1.90	0.74	4.10	1.52	5.40	2.73

	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	Mean PPI for Firm
TAMPA - WL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)	3.60	1.90	13.60	-7.01	4.80	5.40	3.71
Med. user - 200 mins							
PPI (CPI change - price change * 100)	3.60	1.90	13.86	4.10	4.80	5.40	5.61
Large user - 500 mins							
PPI (CPI change - price change * 100)	3.60	1.90	13.86	4.10	4.80	5.40	5.61
Mean PPI for firm	3.60	1.90	13.77	0.40	4.80	5.40	4.98
TAMPA - NWL Firm							
Small user - 0-50 mins							
PPI (CPI change - price change * 100)				4.10	4.80	1.32	
Med. user - 200 mins							
PPI (CPI change - price change * 100)				11.99	4.80	-3.17	
Large user - 500 mins							
PPI (CPI change - price change * 100)				4.10	4.80	5.40	
Mean PPI for firm				6.73	4.80	1.18	4.24
Mean PPI - Small users	2.65	0.38	3.41	1.26	6.06	7.38	3.52
Mean PPI - Med. users	3.26	2.36	4.42	5.00	4.39	5.50	4.16
Mean PPI - Large users	8.86	2.25	6.29	5.65	1.53	6.12	5.12
Mean PPI - All users, all markets	4.92	1.66	4.71	3.97	3.99	6.33	4.26
	4.92	1.66	4.71	3.97	3.99	6.33	4.26
% change in CPI	3.60	1.90	3.60	4.10	4.80	5.40	4.34

APPENDIX C

PRICE DIFFERENTIAL INDEX (PDI)

(% difference between prices charged by competing firms)

	Jan. '85	Jan. '86	Jan. '87	Jan. '88	Jan. '89	Jan. '90	Jan. '91	All Years (Weighted)
ATLANTA								
Small user - 0-50 mins	0.40	0.35	0.35	0.35	0.35	0.35	0.35	
Small user - 0-50 mins				0.35	0.35	0.35	0.35	
PDI	NA	NA	NA	0	0	0	0	0
Med. user - 200 mins	0.38	0.25	0.25	0.25	0.25	0.25	0.25	
Med. user - 200 mins				0.25	0.25	0.25	0.25	
PDI	NA	NA	NA	0	0	0	0	0
Large user - 500 mins	0.37	0.25	0.25	0.25	0.25	0.25	0.25	
Large user - 500 mins				0.25	0.25	0.25	0.25	
PDI	NA	NA	NA	0	0	0	0	0
PDI for Market (PDI-M)	NA	NA	NA	0	0	0	0	0
BALT-WASH								
Small user - 0-50 mins	0.45	0.65	0.65	0.65	0.65	0.65	0.65	
Small user - 0-50 mins	0.75	0.60	0.60	0.60	0.60	0.60	0.39	
PDI	40	7.69	7.69	7.69	7.69	7.69	40	16.92
Med. user - 200 mins	0.36	0.36	0.36	0.36	0.39	0.36	0.36	
Med. user - 200 mins	0.40	0.40	0.40	0.40	0.40	0.40	0.49	
PDI	10	10	10	10	2.5	10	26.53	11.29
Large user - 500 mins	0.36	0.36	0.36	0.36	0.36	0.36	0.36	
Large user - 500 mins	0.40	0.36	0.36	0.36	0.36	0.40	0.39	
PDI	10	0	0	0	0	10	7.69	3.96
PDI for Market (PDI-M)	20	5.90	5.90	5.90	3.40	9.23	24.74	10.72
BOSTON								
Small user - 0-50 mins	0.65	0.65	0.65	0.65	0.65	0.65	0.52	
Small user - 0-50 mins	0.75	0.75	0.75	0.75	0.75	0.45	0.44	
PDI	13.33	13.33	13.33	13.33	13.33	30.77	15.38	16.12
Med. user - 200 mins	0.45	0.45	0.45	0.45	0.45	0.45	0.52	
Med. user - 200 mins	0.44	0.42	0.42	0.42	0.42	0.42	0.42	
PDI	2.22	6.67	6.67	6.67	6.67	6.67	19.23	7.83
Large user - 500 mins	0.35	0.35	0.35	0.35	0.35	0.35	0.42	
Large user - 500 mins	0.44	0.35	0.35	0.35	0.35	0.35	0.35	
PDI	20.45	0	0	0	0	0	16.67	5.30
PDI for Market (PDI-M)	12.00	6.67	6.67	6.67	6.67	12.48	17.09	9.75

	Jan. '85	Jan. '86	Jan. '87	Jan. '88	Jan. '89	Jan. '90	Jan. '91	All Years (Weighted)
BUFFALO								
Small user - 0-50 mins	0.40	0.40	0.40	0.40	0.40	0.35	0.35	
Small user - 0-50 mins	0.32	0.32	0.32	0.32	0.32	0.42	0.42	
PDI	20	20	20	20	20	16.67	16.67	19.05
Med. user - 200 mins	0.30	0.30	0.30	0.30	0.30	0.34	0.34	
Med. user - 200 mins	0.32	0.30	0.30	0.30	0.32	0.34	0.34	
PDI	6.25	0	0	0	6.25	0	0	1.79
Large user - 500 mins	0.30	0.25	0.25	0.25	0.25	0.30	0.30	
Large user - 500 mins	0.32	0.27	0.27	0.27	0.32	0.34	0.34	
PDI	6.25	7.41	7.41	7.41	21.88	11.76	11.76	10.55
PDI for Market (PDI-M)	10.83	9.14	9.14	9.14	16.04	9.48	9.48	10.46
CHICAGO								
Small user - 0-50 mins	0.80	0.60	0.60	0.65	0.65	0.65	0.38	
Small user - 0-50 mins	0.70	0.70	0.70	0.70	0.65	0.65	0.65	
PDI	12.5	14.29	14.29	7.14	0	0	41.54	12.82
Med. user - 200 mins	0.38	0.38	0.38	0.38	0.35	0.35	0.34	
Med. user - 200 mins	0.32	0.32	0.32	0.32	0.32	0.32	0.32	
PDI	15.79	15.79	15.79	15.79	8.57	8.57	5.88	12.31
Large user - 500 mins	0.38	0.38	0.38	0.38	0.30	0.30	0.30	
Large user - 500 mins	0.27	0.27	0.27	0.27	0.27	0.27	0.27	
PDI	28.95	28.95	28.95	28.95	10	10	10	20.83
PDI for Market (PDI-M)	19.08	19.67	19.67	17.29	6.19	6.19	19.14	15.32
CINCINNATI								
Small user - 0-50 mins		0.60	0.60	0.60	0.65	0.60	0.60	
Small user - 0-50 mins			0.55	0.55	0.55	0.60	0.60	
PDI		NA	8.33	8.33	15.38	0	0	6.41
Med. user - 200 mins		0.35	0.35	0.35	0.35	0.34	0.34	
Med. user - 200 mins			0.35	0.35	0.35	0.34	0.34	
PDI		NA	0	0	0	0	0	0
Large user - 500 mins		0.25	0.25	0.25	0.25	0.32	0.32	
Large user - 500 mins			0.25	0.25	0.25	0.33	0.33	
PDI		NA	0	0	0	3.03	3.03	1.21
PDI for Market (PDI-M)		NA	2.78	2.78	5.13	1.01	1.01	2.54

	Jan. '85	Jan. '86	Jan. '87	Jan. '88	Jan. '89	Jan. '90	Jan. '91	All Years (Weighted)
CLEVELAND								
Small user - 0-50 mins	0.60	0.55	0.55	0.55	0.55	0.55	0.55	
Small user - 0-50 mins		0.55	0.55	0.55	0.55	0.60	0.60	
PDI	NA	0	0	0	0	8.33	8.33	2.78
Med. user - 200 mins	0.39	0.36	0.36	0.36	0.36	0.36	0.36	
Med. user - 200 mins		0.35	0.35	0.35	0.35	0.34	0.34	
PDI	NA	2.78	2.78	2.78	2.78	5.56	5.56	3.70
Large user - 500 mins	0.39	0.33	0.33	0.33	0.33	0.29	0.29	
Large user - 500 mins		0.35	0.35	0.35	0.35	0.33	0.33	
PDI	NA	5.71	5.71	5.71	5.71	12.12	12.12	7.85
PDI for Market (PDI-M)	NA	2.83	2.83	2.83	2.83	8.67	8.67	4.78
DALLAS								
Small user - 0-50 mins	0.38	0.38	0.60	0.60	0.60	0.60	0.60	
Small user - 0-50 mins			0.60	0.60	0.60	0.60	0.49	
PDI	NA	NA	0	0	0	0	18.33	3.67
Med. user - 200 mins	0.38	0.38	0.38	0.38	0.35	0.35	0.35	
Med. user - 200 mins			0.38	0.38	0.342	0.342	0.38	
PDI	NA	NA	0	0	2.29	2.29	7.89	2.49
Large user - 500 mins	0.38	0.38	0.34	0.34	0.30	0.30	0.30	
Large user - 500 mins			0.34	0.34	0.30	0.312	0.30	
PDI	NA	NA	0	0	0	3.846	0	0.769
PDI for Market (PDI-M)	NA	NA	0	0	0.76	2.04	8.74	2.31
DENVER								
Small user - 0-50 mins	0.60	0.60	0.60	0.60	0.56	0.56	0.56	
Small user - 0-50 min.			0.70	0.70	0.70	0.70	0.70	
PDI	NA	NA	14.29	14.29	20	20	20	17.71
Med. user - 200 mins	0.40	0.40	0.38	0.38	0.39	0.43	0.43	
Med. user - 200 mins			0.38	0.38	0.38	0.36	0.34	
PDI	NA	NA	0	0	2.56	16.28	20.93	7.95
Large user - 500 mins	0.39	0.36	0.36	0.36	0.36	0.37	0.37	
Large user - 500 mins			0.35	0.35	0.27	0.30	0.31	
PDI	NA	NA	2.78	2.78	25	18.92	16.22	13.14
PDI for Market (PDI-M)	NA	NA	5.69	5.69	15.85	18.40	19.05	12.94

	Jan. '85	Jan. '86	Jan. '87	Jan. '88	Jan. '89	Jan. '90	Jan. '91	All Years (Weighted)
DETROIT								
Small user - 0-50 mins	0.80	0.80	0.60	0.60	0.56	0.65	0.60	
Small user - 0-50 mins		0.80	0.80	0.80	0.35	0.55	0.55	
PDI	NA	0	25	25	37.5	15.38	8.33	18.54
Med. user - 200 mins	0.35	0.35	0.35	0.35	0.33	0.33	0.33	
Med. user - 200 mins		0.29	0.29	0.29	0.29	0.33	0.33	
PDI	NA	17.14	17.14	17.14	12.12	0	0	10.59
Large user - 500 mins	0.30	0.30	0.33	0.28	0.27	0.27	0.27	
Large user - 500 mins		0.23	0.23	0.23	0.23	0.27	0.24	
PDI	NA	23.33	30.30	17.86	14.81	0	11.11	16.24
PDI for Market (PDI-M)	NA	13.49	24.15	20	21.48	5.13	6.48	15.12
HOUSTON								
Small user - 0-50 mins	0.60	0.60	0.60	0.48	0.48	0.48	0.48	
Small user - 0-50 mins			0.60	0.60	0.60	0.60	0.60	
PDI	NA	NA	0	20	20	20	20	16
Med. user - 200 mins	0.39	0.39	0.39	0.312	0.312	0.312	0.312	
Med. user - 200 mins			0.40	0.40	0.40	0.40	0.40	
PDI	NA	NA	2.5	22	22	22	22	18.1
Large user - 500 mins	0.39	0.39	0.39	0.312	0.312	0.312	0.312	
Large user - 500 mins			0.39	0.39	0.39	0.39	0.39	
PDI	NA	NA	0	20	20	20	20	16
PDI for Market (PDI-M)	NA	NA	0.83	20.67	20.67	20.67	20.67	16.7
INDIANAPOLIS								
Small user - 0-50 mins	0.50	0.50	0.50	0.45	0.45	0.45	0.45	
Small user - 0-50 mins	0.75	0.50	0.50	0.50	0.50	0.50	0.32	
PDI	33.33	0	0	10	10	10	28.89	13.17
Med. user - 200 mins	0.33	0.33	0.33	0.30	0.30	0.30	0.30	
Med. user - 200 mins	0.27	0.27	0.27	0.33	0.33	0.30	0.24	
PDI	18.18	18.18	18.18	9.09	9.09	0	20	13.25
Large user - 500 mins	0.33	0.33	0.33	0.24	0.24	0.24	0.24	
Large user - 500 mins	0.27	0.27	0.27	0.25	0.25	0.24	0.22	
PDI	18.18	18.18	18.18	4	4	0	8.33	10.13
PDI for Market (PDI-M)	23.23	12.12	12.12	7.70	7.70	3.33	19.07	12.18

	Jan. '85	Jan. '86	Jan. '87	Jan. '88	Jan. '89	Jan. '90	Jan. '91	All Years (Weighted)
KANSAS CITY								
Small user - 0-50 mins	0.55	0.55	0.55	0.55	0.55	0.55	0.55	
Small user - 0-50 mins			0.55	0.55	0.55	0.55	0.55	
PDI	NA	NA	0	0	0	0	0	0
Med. user - 200 mins	0.32	0.32	0.32	0.32	0.32	0.30	0.35	
Med. user - 200 mins			0.32	0.31	0.31	0.27	0.27	
PDI	NA	NA	0	3.13	3.13	10	22.86	7.82
Large user - 500 mins	0.27	0.26	0.27	0.27	0.27	0.26	0.35	
Large user - 500 mins			0.27	0.20	0.20	0.24	0.24	
PDI	NA	NA	0	25.93	25.93	7.69	31.43	18.19
PDI for Market (PDI-M)	NA	NA	0	9.68	9.68	5.90	18.10	8.67
LOS ANGELES								
Small user - 0-50 mins	0.45	0.90	0.90	0.90	0.99	0.99	0.99	
Small user - 0-50 mins				0.90	0.90	0.90	0.9	
PDI	NA	NA	NA	0	9.09	9.09	9.09	6.82
Med. user - 200 mins	0.45	0.45	0.45	0.45	0.45	0.45	0.45	
Med. user - 200 mins				0.45	0.45	0.45	0.45	
PDI	NA	NA	NA	0	0	0	0	0
Large user - 500 mins	0.45	0.45	0.45	0.45	0.45	0.45	0.45	
Large user - 500 mins				0.45	0.45	0.45	0.45	
PDI	NA	NA	NA	0	0	0	0	0
PDI for Market (PDI-M)	NA	NA	NA	0	3.03	3.03	3.03	2.27
MIAMI								
Small user - 0-50 mins	0.40	0.35	0.35	0.35	0.40	0.39	0.39	
Small user - 0-50 mins				0.60	0.60	0.60	0.60	
PDI	NA	NA	NA	41.67	33.33	35	35	36.25
Med. user - 200 mins	0.40	0.35	0.35	0.35	0.37	0.37	0.37	
Med. user - 200 mins				0.32	0.37	0.37	0.39	
PDI	NA	NA	NA	8.57	0	0	5.13	3.42
Large user - 500 mins	0.40	0.29	0.26	0.28	0.32	0.32	0.29	
Large user - 500 mins				0.32	0.27	0.27	0.31	
PDI	NA	NA	NA	12.5	15.63	15.63	6.45	12.55
PDI for Market (PDI-M)	NA	NA	NA	20.91	16.32	16.88	15.53	17.41

	Jan. '85	Jan. '86	Jan. '87	Jan. '88	Jan. '89	Jan. '90	Jan. '91	All Years (Weighted)
MILWAUKEE								
Small user - 0-50 mins	0.80	0.60	0.60	0.65	0.65	0.65	0.65	
Small user - 0-50 mins	0.45	0.40	0.40	0.40	0.40	0.40	0.40	
PDI	43.75	33.33	33.33	38.46	38.46	38.46	38.46	37.75
Med. user - 200 mins	0.25	0.38	0.38	0.38	0.22	0.22	0.22	
Med. user - 200 mins	0.22	0.22	0.22	0.22	0.22	0.22	0.22	
PDI	12	42.11	42.11	42.11	0	0	0	19.76
Large user - 500 mins	0.25	0.30	0.30	0.30	0.22	0.22	0.22	
Large user - 500 mins	0.22	0.22	0.22	0.22	0.22	0.22	0.22	
PDI	12	26.667	26.667	26.667	0	0	0	13.143
PDI for Market (PDI-M)	22.58	34.04	34.04	35.74	12.82	12.82	12.82	23.55
MINNEAPOLIS								
Small user - 0-50 mins	0.60	0.60	0.60	0.60	0.60	0.45	0.42	
Small user - 0-50 mins	0.53	0.53	0.65	0.65	0.60	0.55	0.43	
PDI	11.67	11.67	7.69	7.69	0	18.18	2.33	8.46
Med. user - 200 mins	0.40	0.40	0.38	0.38	0.38	0.39	0.38	
Med. user - 200 mins	0.33	0.33	0.35	0.38	0.38	0.35	0.35	
PDI	17.5	17.5	7.89	0	0	10.26	7.89	8.72
Large user - 500 mins	0.40	0.36	0.36	0.36	0.36	0.38	0.36	
Large user - 500 mins	0.30	0.30	0.32	0.32	0.32	0.32	0.30	
PDI	25	16.67	11.11	11.11	11.11	15.79	16.67	15.35
PDI for Market (PDI-M)	18.06	15.28	8.90	6.27	3.70	14.74	8.96	10.84
NEW ORLEANS								
Small user - 0-50 mins	0.42	0.35	0.35	0.35	0.35	0.35	0.35	
Small user - 0-50 mins		0.33	0.33	0.33	0.33	0.33	0.33	
PDI	NA	5.71	5.71	5.71	5.71	5.71	5.71	5.71
Med. user - 200 mins	0.39	0.35	0.35	0.35	0.35	0.35	0.35	
Med. user - 200 mins		0.33	0.33	0.33	0.33	0.33	0.33	
PDI	NA	5.71	5.71	5.71	5.71	5.71	5.71	5.71
Large user - 500 mins	0.36	0.32	0.32	0.32	0.30	0.30	0.30	
Large user - 500 mins		0.31	0.31	0.31	0.31	0.30	0.30	
PDI	NA	3.13	3.13	3.13	3.23	0	0	2.10
PDI for Market (PDI-M)	NA	4.85	4.85	4.85	4.88	3.81	3.81	4.51

	Jan. '85	Jan. '86	Jan. '87	Jan. '88	Jan. '89	Jan. '90	Jan. '91	All Years (Weighted)
NEW YORK								
Small user - 0-50 mins	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
Small user - 0-50 mins			0.75	0.75	0.75	0.80	0.80	
PDI	NA	NA	16.67	16.67	16.67	11.11	11.11	14.44
Med. user - 200 mins	0.65	0.65	0.65	0.45	0.45	0.45	0.45	
Med. user - 200 mins			0.40	0.40	0.40	0.40	0.40	
PDI	NA	NA	38.46	11.11	11.11	11.11	11.11	16.58
Large user - 500 mins	0.40	0.40	0.40	0.40	0.40	0.40	0.40	
Large user - 500 mins			0.40	0.40	0.40	0.40	0.40	
PDI	NA	NA	0.00	0.00	0.00	0.00	0.00	0.00
PDI for Market (PDI-M)	NA	NA	18.38	9.26	9.26	7.41	7.41	10.34
PHILADELPHIA								
Small user - 0-50 mins	0.45	0.65	0.65	0.65	0.65	0.65	0.75	
Small user - 0-50 mins			0.65	0.65	0.65	0.65	0.74	
PDI	NA	NA	0	0	0	0	1.33	0.27
Med. user - 200 mins	0.45	0.45	0.45	0.50	0.50	0.50	0.50	
Med. user - 200 mins			0.50	0.50	0.50	0.50	0.50	
PDI	NA	NA	10	0	0	0	0	2
Large user - 500 mins	0.45	0.45	0.45	0.45	0.45	0.45	0.40	
Large user - 500 mins			0.45	0.45	0.45	0.45	0.45	
PDI	NA	NA	0	0	0	0	11.11	2.222
PDI for Market (PDI-M)	NA	NA	3.33	0	0	0	4.15	1.50
PHOENIX								
Small user - 0-50 mins	0.60	0.60	0.60	0.60	0.60	0.38	0.45	
Small user - 0-50 mins			0.55	0.55	0.55	0.35	0.40	
PDI	NA	NA	8.33	8.33	8.33	7.89	11.11	8.80
Med. user - 200 mins	0.40	0.40	0.38	0.38	0.38	0.38	0.45	
Med. user - 200 mins			0.35	0.35	0.35	0.35	0.35	
PDI	NA	NA	7.89	7.89	7.89	7.89	22.22	10.76
Large user - 500 mins	0.39	0.36	0.36	0.36	0.36	0.37	0.44	
Large user - 500 mins			0.34	0.36	0.36	0.34	0.34	
PDI	NA	NA	5.56	0	0	8.11	22.73	7.28
PDI for Market (PDI-M)	NA	NA	7.26	5.41	5.41	7.97	18.69	8.95

	Jan. '85	Jan. '86	Jan. '87	Jan. '88	Jan. '89	Jan. '90	Jan. '91	All Years (Weighted)
PITTSBURGH								
Small user - 0-50 mins	0.49	0.65	0.65	0.65	0.65	0.65	0.75	
Small user - 0-50 mins			Missing	0.65	0.65	0.65	0.65	
PDI	NA	NA	NA	0	0	0	13.33	3.33
Med. user - 200 mins	0.49	0.49	0.49	0.47	0.47	0.47	0.37	
Med. user - 200 mins				0.47	0.47	0.47	0.38	
PDI	NA	NA	NA	0	0	0	2.63	0.66
Large user - 500 mins	0.49	0.49	0.49	0.47	0.47	0.47	0.37	
Large user - 500 mins				0.47	0.47	0.47	0.38	
PDI	NA	NA	NA	0	0	0	2.63	0.66
PDI for Market (PDI-M)	NA	NA	NA	0	0	0	6.20	1.55
PORTLAND								
Small user - 0-50 mins		0.38	0.38	0.35	0.35	0.35	0.35	
Small user - 0-50 mins		0.68	0.68	0.38	0.38	0.38	0.33	
PDI		44.12	44.12	7.89	7.89	7.89	5.71	19.61
Med. user - 200 mins		0.38	0.38	0.38	0.35	0.35	0.35	
Med. user - 200 mins		0.38	0.38	0.35	0.35	0.35	0.29	
PDI		0	0	7.89	0	0	17.14	4.17
Large user - 500 mins		0.38	0.38	0.34	0.34	0.34	0.34	
Large user - 500 mins		0.38	0.38	0.35	0.35	0.35	0.25	
PDI		0	0	2.86	2.86	2.86	26.47	5.84
PDI for Market (PDI-M)		14.71	14.71	6.22	3.58	3.58	16.44	9.87
ST. LOUIS								
Small user - 0-50 mins	0.50	0.50	0.50	0.50	0.50	0.50	0.50	
Small user - 0-50 mins	0.60	0.44	0.50	0.50	0.50	0.50	0.50	
PDI	16.67	12	0	0	0	0	0	4.10
Med. user - 200 mins	0.34	0.34	0.34	0.34	0.34	0.34	0.34	
Med. user - 200 mins	0.34	0.34	0.34	0.34	0.34	0.34	0.28	
PDI	0	0	0	0	0	0	17.65	2.52
Large user - 500 mins	0.28	0.28	0.28	0.28	0.28	0.28	0.28	
Large user - 500 mins	0.28	0.28	0.28	0.28	0.28	0.28	0.28	
PDI	0	0	0	0	0	0	0	0
PDI for Market (PDI-M)	5.56	4	0	0	0	0	5.88	2.21

	Jan. '85	Jan. '86	Jan. '87	Jan. '88	Jan. '89	Jan. '90	Jan. '91	All Years (Weighted)
SAN DIEGO								
Small user - 0-50 mins		0.40	0.40	0.74	0.74	0.74	0.74	
Small user - 0-50 mins			0.40	0.40	0.40	0.40	0.40	
PDI		NA	0	45.95	45.95	45.95	45.95	36.76
Med. user - 200 mins		0.40	0.40	0.40	0.40	0.40	0.40	
Med. user - 200 mins			0.40	0.35	0.35	0.35	0.35	
PDI		NA	0	12.5	12.5	12.5	12.5	10
Large user - 500 mins		0.40	0.40	0.36	0.36	0.40	0.36	
Large user - 500 mins			0.40	0.35	0.35	0.35	0.35	
PDI		NA	0	2.78	2.78	12.5	2.78	4.17
PDI for Market (PDI-M)		NA	0	20.41	20.41	23.65	20.41	16.97
SAN FRAN - SAN JOSE								
Small user - 0-50 mins		0.45	0.45	0.45	0.90	0.90	0.90	
Small user - 0-50 mins			0.45	0.45	0.90	0.90	0.90	
PDI		NA	0	0	0	0	0	0.00
Med. user - 200 mins		0.45	0.45	0.45	0.45	0.45	0.45	
Med. user - 200 mins			0.45	0.45	0.45	0.45	0.45	
PDI		NA	0	0	0	0	0	0.00
Large user - 500 mins		0.45	0.45	0.45	0.45	0.45	0.45	
Large user - 500 mins			0.45	0.45	0.45	0.45	0.45	
PDI		NA	0	0	0	0	0	0.00
PDI for Market (PDI-M)		NA	0	0	0	0	0	0.00
SEATTLE								
Small user - 0-50 mins	0.60	0.60	0.56	0.56	0.56	0.49	0.54	
Small user - 0-50 mins		0.70	0.70	0.70	0.70	0.57	0.57	
PDI	NA	14.29	20	20	20	14.04	5.26	15.60
Med. user - 200 mins	0.40	0.40	0.36	0.38	0.38	0.44	0.45	
Med. user - 200 mins		0.35	0.35	0.38	0.38	0.45	0.45	
PDI	NA	12.5	2.78	0	0	2.22	0	2.92
Large user - 500 mins	0.40	0.36	0.31	0.31	0.31	0.42	0.44	
Large user - 500 mins		0.30	0.30	0.30	0.30	0.33	0.33	
PDI	NA	16.67	3.23	3.23	3.23	21.43	25	12.13
PDI for Market (PDI-M)	NA	14.48	8.67	7.74	7.74	12.56	10.09	10.21

	Jan. '85	Jan. '86	Jan. '87	Jan. '88	Jan. '89	Jan. '90	Jan. '91	All Years (Weighted)	
TAMPA									
Small user - 0-50 mins	0.60	0.60	0.60	0.54	0.60	0.60	0.60		
Small user - 0-50 mins				0.49	0.49	0.49	0.51		
PDI	NA	NA	NA	9.26	18.33	18.33	15		15.23
Med. user - 200 mins	0.39	0.39	0.39	0.35	0.35	0.35	0.35		
Med. user - 200 mins				0.38	0.35	0.35	0.38		
PDI	NA	NA	NA	7.89	0	0	7.89		3.95
Large user - 500 mins	0.39	0.39	0.39	0.35	0.35	0.35	0.35		
Large user - 500 mins				0.35	0.35	0.35	0.35		
PDI	NA	NA	NA	0	0	0	0		0
PDI for Market (PDI-M)	NA	NA	NA	5.72	6.11	6.11	7.63		6.39
Mean PDI - Small users	23.91	13.57	10.38	11.69	12.42	12.16	14.89	14.15	12.73
Mean PDI - Med. users	10.24	11.41	8.17	6.80	4.11	4.68	9.31	7.82	6.73
Mean PDI - Large users	15.10	11.29	6.22	6.25	5.93	6.20	9.36	8.62	7.13
Mean PDI - All users, all 1	16.42	12.09	8.26	8.25	7.49	7.68	11.19	10.20	8.86
	16.42	12.09	8.26	8.25	7.49	7.68	11.19		8.86

APPENDIX D

SERVICE DIFFERENTIATION INDEX (SDI)

Mean Adjusted Number of Service Enhancements per Firm
(Enhancements without charge weighted double)

	Jan. '85	Jan. '86	Jan. '87	Jan. '88	Jan. '89	Jan. '90	Jan. '91	Mean of Market*
Atlanta	1.5	1.5	5.5	7.5	7.5	7.75	7.75	5.57
Balt-Wash	5.25	6.25	7.5	8	8	8	8.25	7.32
Boston	1.75	3	3.75	5.5	5.5	5.75	5.75	4.43
Buffalo	1.5	3.75	4	5.25	5.25	6	6	4.54
Chicago	3.75	4	5.5	6	5.75	6.75	7.75	5.64
Cincinnati		3.5	4.5	6	6.25	7	7	5.71
Cleveland	2	3.75	5.5	6.25	6	5	5	4.79
Dallas	0	1.5	5.25	6	6	6.25	6.25	4.46
Denver	3.5	3.5	6	8.25	8.25	7.5	7.5	6.36
Detroit	2	2.75	5.75	7.5	7	7.25	7.25	5.64
Houston	2.5	3.5	5.25	5	5	5	5	4.46
Indianapolis	1.25	1.25	3	4.25	4.25	5	5.25	3.46
Kansas City	2.5	2.5	3.25	4.25	4.25	4.25	4.25	3.61
Los Angeles	1	4	4	6	6	6.25	6.25	4.79
Miami	0	0	4.5	4.25	4.5	4.75	4.75	3.25
Milwaukee	2.5	2.5	3.25	5.75	5.75	6.25	6.25	4.61
Minneapolis	5	5	6.75	6.75	6.75	8	8.75	6.71
New Orleans	3	3	5.5	6.25	5.75	5.5	5.5	4.93
New York	1	1.5	5.75	7.75	7.75	8	8	5.68
Philadelphia	5	6	5.5	7.25	7.25	7.5	7.5	6.57

	Jan. '85	Jan. '86	Jan. '87	Jan. '88	Jan. '89	Jan. '90	Jan. '91	Mean of Market*
Phoenix	3.5	3.5	4.25	8.5	8.75	9	9	6.64
Pittsburgh	5	5	8	8	8	8.5	8.5	7.29
Portland		1.5	5.75	6.25	6.25	6.25	6.25	5.38
St. Louis	2.25	2.25	4.5	5	5	5.75	5.75	4.36
San Diego		0	3	5.5	5.5	5.5	5.5	4.17
San Fran-San Jose		0	5	6.75	6.75	7	6.5	5.33
Seattle	3.5	3.5	5.25	6.5	7.5	7.5	8.5	6.04
Tampa	0	0	3.5	6.25	6.75	6.75	6.5	4.25
Mean of All Markets*	2.47	2.80	4.97	6.30	6.33	6.57	6.66	5.21

*Excluding markets with zero entrants

APPENDIX E

SEGMENTATION INDEX (SI)

Total Retail Pricing Plans in Market

	Jan. '85	Jan. '86	Jan. '87	Jan. '88	Jan. '89	Jan. '90	Jan. '91	Mean of Market*
Atlanta	1	4	3	8	11	11	12	7.14
Balt-Wash	10	13	13	14	14	14	9	12.43
Boston	7	9	9	9	9	8	10	8.71
Buffalo	7	10	11	11	13	13	15	11.43
Chicago	8	8	8	9	15	15	16	11.29
Cincinnati		4	7	9	9	12	15	9.33
Cleveland	2	4	4	4	4	9	9	5.14
Dallas	1	1	6	6	6	10	12	6.00
Denver	4	5	11	11	8	4	10	7.57
Detroit	4	8	7	8	10	14	17	9.71
Houston	2	2	5	9	9	9	9	6.43
Indianapolis	10	10	10	10	10	10	9	9.86
Kansas City	3	3	6	8	11	16	11	8.29
Los Angeles	1	7	7	15	16	16	18	11.43
Miami	2	4	4	14	9	8	12	7.57
Milwaukee	7	7	7	8	9	9	12	8.43
Minneapolis	7	7	9	10	8	6	10	8.14
New Orleans	1	3	3	5	5	10	10	5.29
New York	5	6	9	6	6	6	6	6.29
Philadelphia	5	4	7	8	9	9	16	8.29
Phoenix	4	5	7	10	10	4	6	6.57

	Jan. '85	Jan. '86	Jan. '87	Jan. '88	Jan. '89	Jan. '90	Jan. '91	Mean of Market*
Pittsburgh	3	3	3	8	10	10	7	6.29
Portland		6	5	9	9	10	11	8.33
St. Louis	6	12	9	11	11	11	10	10.00
San Diego		1	2	6	6	5	7	4.50
San Fran-San Jose		1	2	2	4	6	7	3.67
Seattle	4	10	9	13	12	7	8	9.00
Tampa	2	2	2	5	7	13	12	6.14
Mean of All Markets*	4.42	5.68	6.61	8.79	9.29	9.82	10.93	7.97

*Excluding years with zero entrants

APPENDIX F

TABLE OF SELECTED RESULTS

Market, Firm	Firm PPI Mean of Yrs. Oper.	PPI Mean of Market	PDI-M Mean of Market	SI Mean of Market*	SDI Mean of Market*
Atlanta		5.58	0	7.14	5.57
Wireline Firm	6.40				
Non-wireline Firm	4.77				
Balt-Wash		3.59	10.72	12.43	7.32
Wireline Firm	1.40				
Non-wireline Firm	5.78				
Boston		5.34	9.75	8.71	4.43
Wireline Firm	3.04				
Non-wireline Firm	7.63				
Buffalo		2.48	10.46	11.43	4.54
Wireline Firm	3.67				
Non-wireline Firm	1.29				
Chicago		6.60	15.32	11.29	5.64
Wireline Firm	8.90				
Non-wireline Firm	4.30				
Cincinnati		1.76	2.54	9.33	5.71
Wireline Firm	2.24				
Non-wireline Firm	1.29				
Cleveland		5.12	4.78	5.14	4.79
Wireline Firm	6.32				
Non-wireline Firm	3.93				
Dallas		4.62	2.31	6.00	4.46
Wireline Firm	2.36				
Non-wireline Firm	6.88				
Denver		5.09	12.94	7.57	6.36
Wireline Firm	4.11				
Non-wireline Firm	6.08				
Detroit		4.28	15.12	9.71	5.64
Wireline Firm	6.00				
Non-wireline Firm	2.56				

Market, Firm	Firm PPI Mean of Yrs. Oper.	PPI Mean of Market	PDI-M Mean of Market	SI Mean of Market*	SDI Mean of Market*
Houston		5.85	16.70	6.43	4.46
Wireline Firm	7.23				
Non-wireline Firm	4.48				
Indianapolis		7.85	12.18	9.86	3.46
Wireline Firm	6.48				
Non-wireline Firm	9.23				
Kansas City		3.95	8.67	8.29	3.61
Wireline Firm	1.60				
Non-wireline Firm	6.30				
Los Angeles		1.28	2.27	11.43	4.79
Wireline Firm	-2.21				
Non-wireline Firm	4.77				
Miami		4.12	17.41	7.57	3.25
Wireline Firm	5.72				
Non-wireline Firm	2.52				
Milwaukee		4.58	23.55	8.43	4.61
Wireline Firm	4.65				
Non-wireline Firm	4.52				
Minneapolis		5.41	10.84	8.14	6.71
Wireline Firm	6.47				
Non-wireline Firm	4.35				
New Orleans		5.27	4.51	5.29	4.93
Wireline Firm	6.36				
Non-wireline Firm	4.18				
New York		4.76	10.34	6.29	5.68
Wireline Firm	5.61				
Non-wireline Firm	3.92				
Philadelphia		1.95	1.50	8.29	6.57
Wireline Firm	0.58				
Non-wireline Firm	3.32				
Phoenix		4.84	8.95	6.57	6.64
Wireline Firm	3.39				
Non-wireline Firm	6.29				
Pittsburgh		6.54	1.55	6.29	7.29
Wireline Firm	4.05				
Non-wireline Firm	9.02				

Market, Firm	Firm PPI Mean of Yrs. Oper.	PPI Mean of Market	PDI-M Mean of Market	SI Mean of Market*	SDI Mean of Market*
Portland		8.80	9.87	8.33	5.38
Wireline Firm	5.71				
Non-wireline Firm	11.88				
St. Louis		4.75	2.21	10.00	4.36
Wireline Firm	3.90				
Non-wireline Firm	5.60				
San Diego		2.72	16.97	4.50	4.17
Wireline Firm	-1.11				
Non-wireline Firm	6.56				
San Fran - San Jose		-2.90	0.00	3.67	5.33
Wireline Firm	-2.71				
Non-wireline Firm	-3.09				
Seattle		2.73	10.21	9.00	6.04
Wireline Firm	2.733				
Non-wireline Firm	2.732				
Tampa		4.61	6.39	6.14	4.25
Wireline Firm	4.98				
Non-wireline Firm	4.24				
Mean of All Markets	4.34	4.34	8.86	7.97	5.21

*Excluding years with zero entrants

APPENDIX G

SORTS BY INDEX IN DESCENDING ORDER

Market	PPI	Rank	Market	PDI	PP1	Market	S1	PP1	Market	SD1	PP1
	Mean of			Mean of			Mean of			Mean of	
	Market			Market			Market*			Market*	
Portland	8.80	1	Milwaukee	23.55	16	Balt-Wash	12.43	21	Balt-Wash	7.32	21
Indianapolis	7.85	2	Miami	17.41	19	Buffalo	11.43	24	Pittsburgh	7.29	4
Chicago	6.60	3	San Diego	16.97	23	Los Angeles	11.43	27	Minneapolis	6.71	7
Pittsburgh	6.54	4	Houston	16.70	5	Chicago	11.29	3	Phoenix	6.64	12
Houston	5.85	5	Chicago	15.32	3	St. Louis	10.00	13	Philadelphia	6.57	25
Atlanta	5.58	6	Detroit	15.12	18	Indianapolis	9.86	2	Denver	6.36	11
Minneapolis	5.41	7	New York	10.34	17	Detroit	9.71	18	Seattle	6.04	22
Boston	5.34	8	Denver	12.94	11	Cincinnati	9.33	26	Cincinnati	5.71	26
New Orleans	5.27	9	Indianapolis	12.18	2	Seattle	9.00	22	New York	5.68	17
Cleveland	5.12	10	Minneapolis	10.84	7	Boston	8.71	8	Chicago	5.64	3
Denver	5.09	11	Balt-Wash	10.72	21	Milwaukee	8.43	16	Detroit	5.64	18
Phoenix	4.84	12	Buffalo	10.46	24	Portland	8.33	1	Atlanta	5.57	6
St. Louis	4.75	13	Seattle	10.21	22	Kansas City	8.29	20	Portland	5.38	1
Dallas	4.62	14	Portland	9.87	1	Philadelphia	8.29	25	SanFran-SJ	5.33	28
Tampa	4.61	15	Boston	9.75	8	Minneapolis	8.14	7	New Orleans	4.93	9
Milwaukee	4.58	16	Phoenix	8.95	12	Denver	7.57	11	Cleveland	4.79	10
New York	4.76	17	Kansas City	8.67	20	Miami	7.57	19	Los Angeles	4.79	23
Detroit	4.28	18	Tampa	6.39	15	Atlanta	7.14	6	Milwaukee	4.61	16
Miami	4.12	19	Cleveland	4.78	10	Phoenix	6.57	12	Buffalo	4.54	24
Kansas City	3.95	20	New Orleans	4.51	9	Houston	6.43	5	Dallas	4.46	14
Balt-Wash	3.59	21	Cincinnati	2.54	26	New York	6.29	17	Houston	4.46	5
Seattle	2.73	22	Dallas	2.31	14	Pittsburgh	6.29	4	Boston	4.43	8
San Diego	2.72	23	Los Angeles	2.27	23	Tampa	6.14	15	St. Louis	4.36	13
Buffalo	2.48	24	St. Louis	2.21	13	Dallas	6.00	14	Tampa	4.25	15
Philadelphia	1.95	25	Pittsburgh	1.55	4	New Orleans	5.29	9	San Diego	4.17	23
Cincinnati	1.76	26	Philadelphia	1.50	25	Cleveland	5.14	10	Kansas City	3.61	20
Los Angeles	1.28	27	Atlanta	0	6	San Diego	4.50	23	Indianapolis	3.46	2
SanFran-SJ	-2.90	28	SanFran-SJ	0	28	SanFran-SJ	3.67	28	Miami	3.25	19
MEAN PPI	4.34		MEAN PDI	8.86		MEAN S1	7.97		MEAN SD1	5.21	

*Excluding years with zero entrants

Note. PPI is repeated in each table for purposes of comparison.

APPENDIX H

FIRMS BY PPI IN DESCENDING ORDER

Market, Firm	Mean of Firm's PPI
Portland Non-wireline Firm	11.88
Indianapolis Non-wireline Firm	9.23
Pittsburgh Non-wireline Firm	9.02
Chicago Wireline Firm	8.90
Boston Non-wireline Firm	7.63
Houston Wireline Firm	7.23
Dallas Non-wireline Firm	6.88
San Diego Non-wireline Firm	6.56
Indianapolis Wireline Firm	6.48
Minneapolis Wireline Firm	6.47
Atlanta Wireline Firm	6.40
New Orleans Wireline Firm	6.36
Cleveland Wireline Firm	6.32
Kansas City Non-wireline Firm	6.30
Phoenix Non-wireline Firm	6.29
Denver Non-wireline Firm	6.08
Detroit Wireline Firm	6.00
Balt-Wash Non-wireline Firm	5.78
Miami Wireline Firm	5.72
Portland Wireline Firm	5.71
St. Louis Non-wireline Firm	5.60
Tampa Wireline Firm	4.98
NY Wireline Firm	5.61
Atlanta Non-wireline Firm	4.77
Los Angeles Non-wireline Firm	4.77
Milwaukee Wireline Firm	4.65
Milwaukee Non-wireline Firm	4.52
Houston Non-wireline Firm	4.48

Market, Firm	Mean of Firm's PPI
Minneapolis Non-wireline Firm	4.35
MEAN OF FIRMS' PPI	4.34
Chicago Non-wireline	4.30
Tampa Non-wireline Firm	4.24
New Orleans Non-wireline Firm	4.18
Denver Wireline Firm	4.11
Pittsburgh Wireline Firm	4.05
Cleveland Non-wireline Firm	3.93
New York Non-wireline Firm	3.92
St. Louis Wireline Firm	3.90
Buffalo Wireline Firm	3.67
Phoenix Wireline Firm	3.39
Philadelphia Non-wireline Firm	3.32
Boston Wireline Firm	3.04
Seattle Wireline Firm	2.733
Seattle Non-wireline Firm	2.732
Detroit Non-wireline Firm	2.56
Miami Non-wireline	2.52
Dallas Wireline Firm	2.36
Cincinnati Wireline Firm	2.24
Kansas City Wireline Firm	1.60
Balt-Wash Wireline Firm	1.40
Cincinnati Non-wireline Firm	1.29
Buffalo Non-wireline Firm	1.29
Philadelphia Wireline Firm	0.58
San Diego Wireline Firm	-1.11
Los Angeles Wireline Firm	-2.21
San Fran-San Jose Wireline Firm	-2.71
San Fran-San Jose Non-wireline Firm	-3.09
	4.34

APPENDIX I

CORRELATIONS

Correlations of Index Rank Order

PPI to PDI	0.1312
PPI to SI	-0.0429
PPI to SDI	0.0062
PDI to SI	0.1284
PDI to SDI	-0.2574
SI to SDI	0.2255

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BIOGRAPHICAL SKETCH

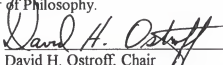
Working journalist and journalism educator Hugh S. Fullerton is currently practicing his profession in Bulgaria, where he is an associate professor of journalism and mass communications at the American University in Bulgaria.

Prof. Fullerton began his journalistic career at the age of 16 and worked in journalism regularly for more than 30 years as a reporter, editor, and newspaper publisher. He has worked for newspapers ranging in size from several hundred circulation to more than 600,000. For more than a decade he owned and published community newspapers in three Midwestern states.

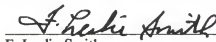
Prof. Fullerton began his university teaching career in 1982, and has taught continuously since then at four universities and colleges in the U.S. and Bulgaria. His professional interests have broadened to include the communications processes involved in the mass media.

Prof. Fullerton holds the Bachelor of Science in Journalism and Master of Science in Journalism degrees from Northwestern University and the Master in Business Administration degree from Western Michigan University.

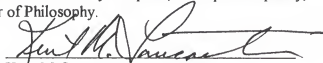
I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.


David H. Ostroff, Chair
Professor of Journalism and Communications

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F. Leslie Smith
Professor of Journalism and Communications

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Kent M. Lancaster
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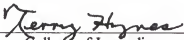

Sanford V. Berg
Distinguished Service Professor of Economics

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Jonathan H. Hamilton
Professor of Economics

This dissertation was submitted to the Graduate Faculty of the College of Journalism and Communications and to the Graduate School and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

December 1996



Dean, College of Journalism and
Communications

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